Hand-Held Windows Shoot-Out

JANUARY 1997

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37 Products Reviewed
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Hewlett-Packard LaserJet 6P
Elevate Notebook Computing
Stellar
Micron Home MPC P200
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Intel Tied At the Top Of the Heap

We broke in our new Winstone 32 benchmark by using it to test systems equipped with Intel's latest, the 200-MHz Pentium processor. Although the new Pentium bumps up system performance, Cyrix's 133-MHz 6x86 matches it when running 32-bit code.

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REVIEWS
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Micron's Millennia Pro Flies High With 200MHz Of Pentium Pro Power

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May 30, 1995 Millennia P120
August 6, 1996 Millennia TransPort P133
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October 1996 Millennia P200
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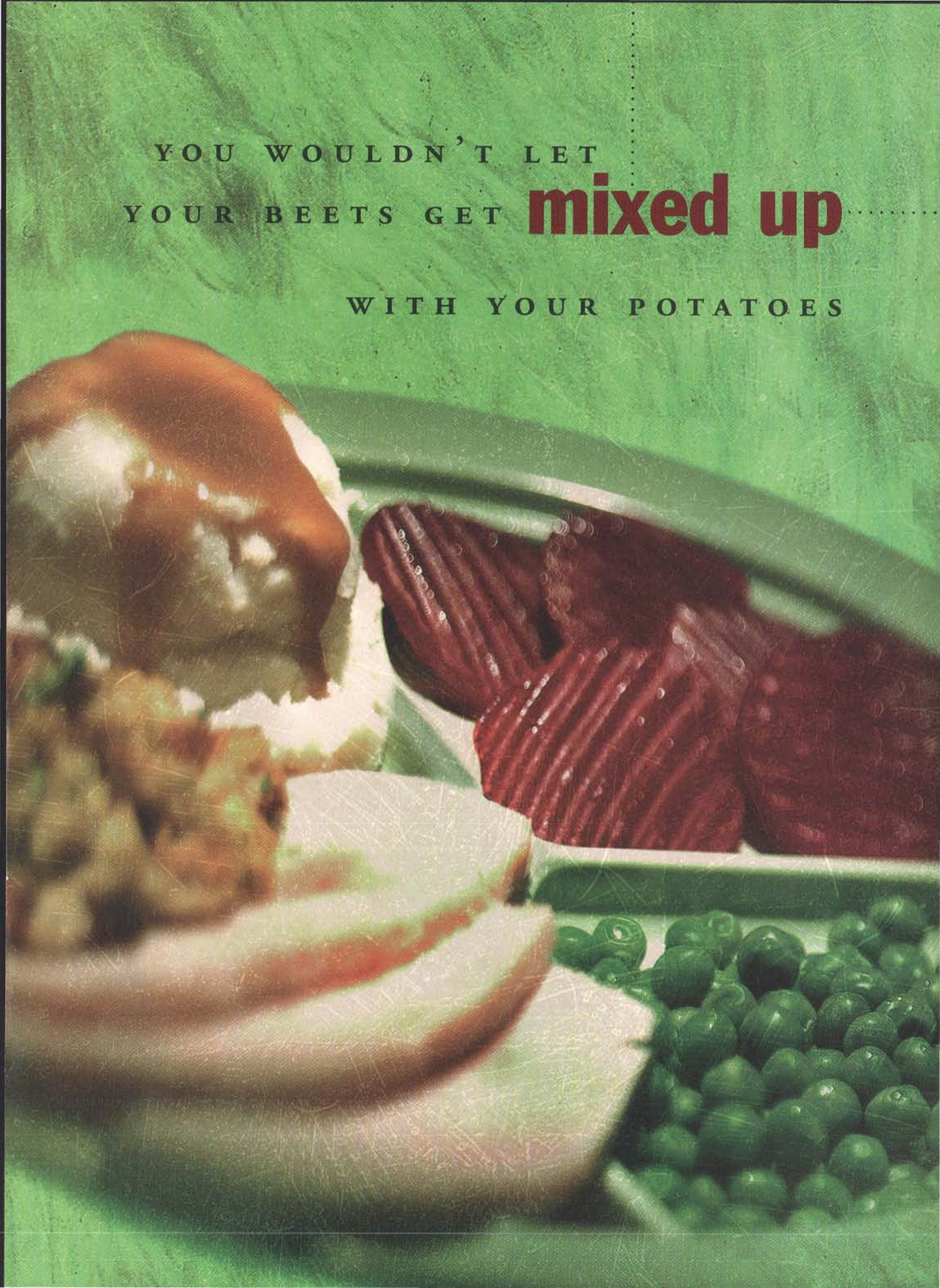
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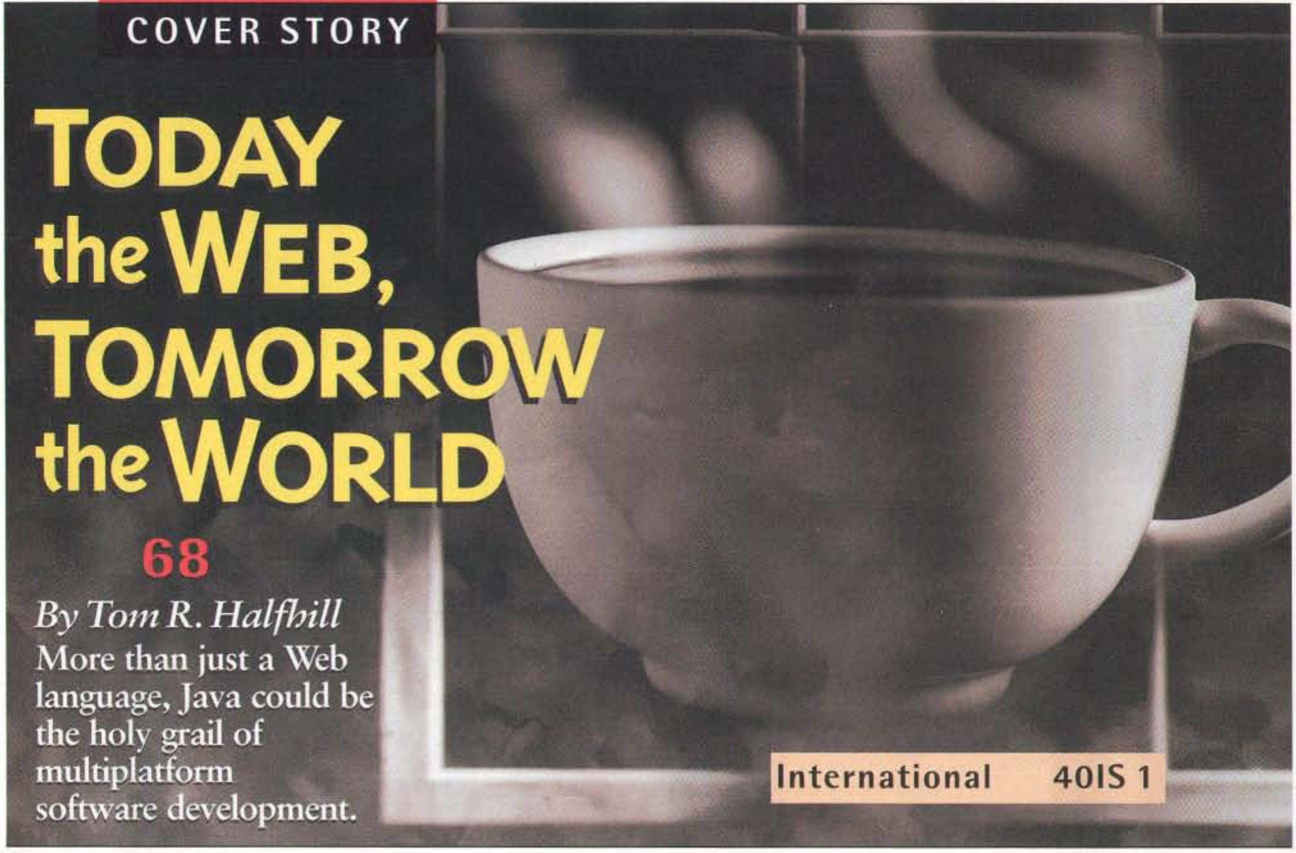

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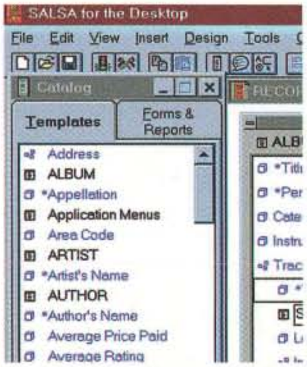

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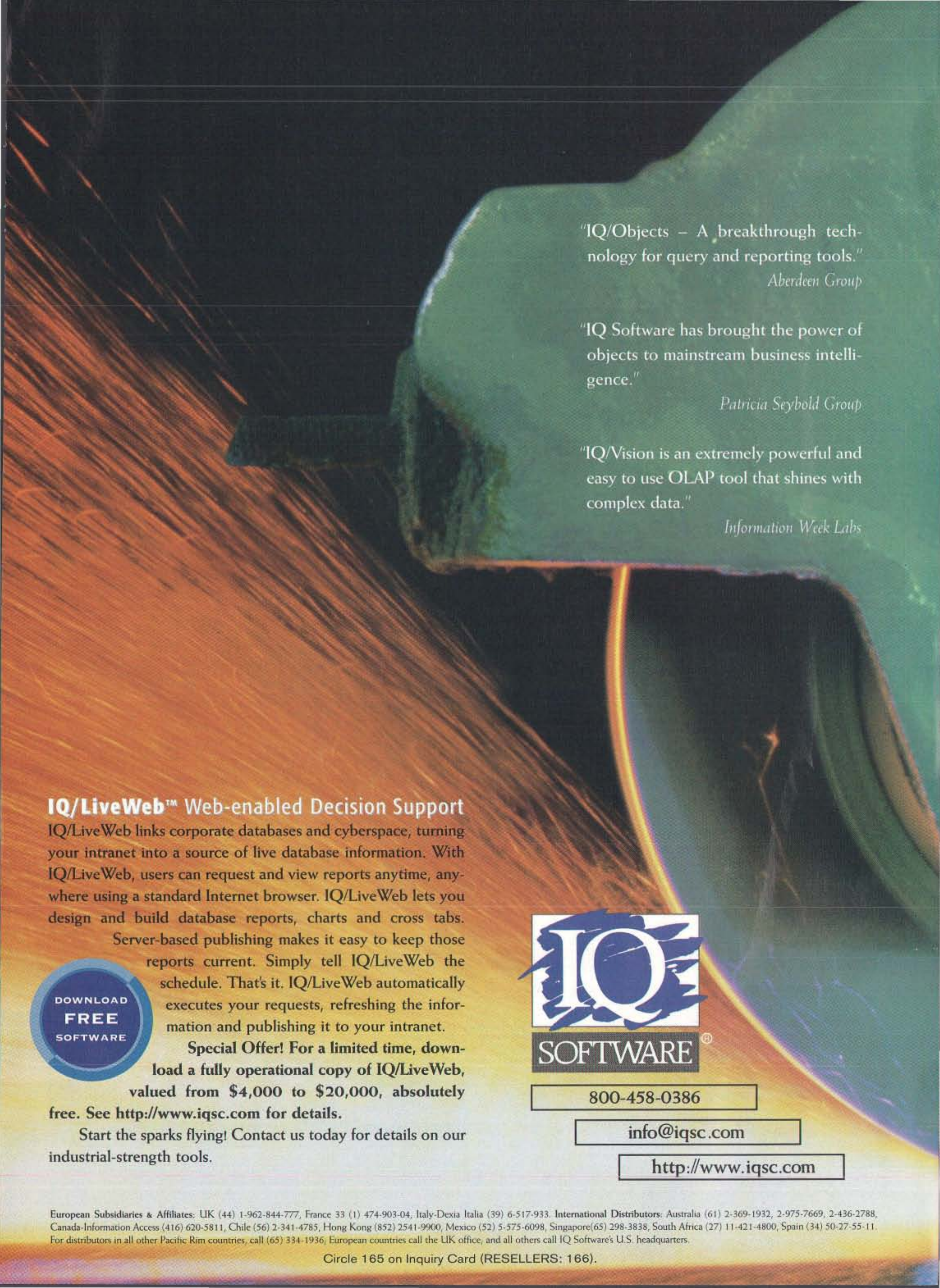

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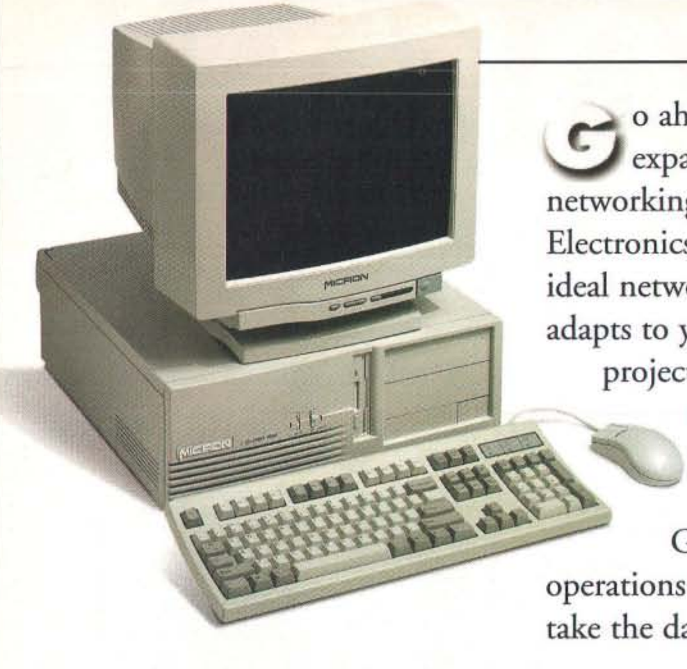

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editorial

Living Dangerously

The computer industry is engaged in a platform war. Which side should you be on?

In one of my favorite movies, *The Year of Living Dangerously*, Linda Hunt explains to Mel Gibson how the shadow puppets of Java mimic the relationship between gods and people. The puppeteer moves the puppets behind the curtain, so the audience sees only shadowy projections on the gauzy material.

Those of you trying to make sense out of all the alternative platform debates may have the same impression that you're not seeing the whole show. And, indeed, it could be a dangerous year if you guess wrong.

Our cover story this month takes on the issue of Java as a development platform, following on our November cover story about Java chips. Java software is clearly a broader platform than the chips, and we explain why.

Meanwhile, more opening shots in a war over who gets to dominate the computer industry were fired in recent months. At issue is what kind of computer is the right kind, and for whom? As the shadow puppets moved furiously around the stage, some of the images came into clearer focus.

BYTE has always taken the position that there is no one true computer platform for everyone, and we'll continue to be skeptical about anyone who says there is. That goes for Wintel as well as its challengers. So here's a scorecard:

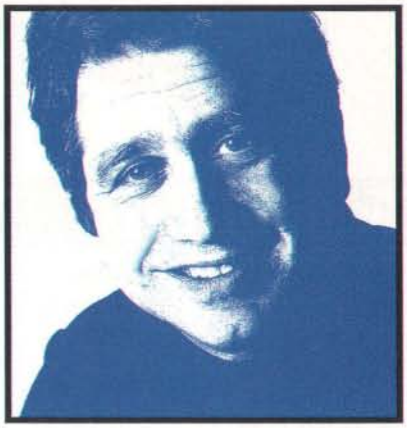
The NC. The Network Computer comes in two distinctly different flavors, anti-Intel and anti-Microsoft. (Well, actually it's more like two different kinds of swirl cones: One's more chocolate, the other more vanilla). Sun's anti-Intel thrust starts with its Java chip; others will use different RISC chips. While Sun has its own servers, there's no reason you couldn't run Java apps off any other server. You can even run Windows apps in emulation mode. At roughly $1500 for a fully configured system, this is worth some serious thought for users with a few dedicated computing tasks of low-to-moderate complexity and little need for multiple peripherals. You'll save on the admin side.

Oracle, on the other hand, thinks Microsoft's Windows NT doesn't cut it. It has a better idea: an Oracle server feeding lots of low-cost (the now legendary $500 machine), low-function Intel boxes (after all, Intel's the volume client leader). Give this serious thought if your aim is to push an application or service into many hands that previously haven't used a computer.

The WebTV. You know your aunt and uncle who are on e-mail now? Perfect for them, plus they can see your new Web site during the commercials. So far, this is the only really sub-$500 platform out there.

Computing is too pervasive to survive on one model anymore, whether it's Wintel or one of the challengers.

The NetPC. The Network PC is a cheap PC, folks. Microsoft and Intel are making a lot of noise about making it easier to configure and manage—wasn't that what Plug and Play was about?—but this time they might mean it. Competition does have its value. If they can deliver, the NetPC is the right platform for what I'll call the low-power user. Many office workers don't really stress a computer, but they do a variety of things, use a variety of peripherals (scanners, digital cameras, bar code readers), and need the flexibility of a machine with slots and hard drives.



In the coming months, you'll hear lots of appeals from all these gods as they fight behind the curtains. Computing is too pervasive and important to survive on one model anymore, whether it's Wintel or one of the challengers. What we all must insist on is that none of these camps builds walls between their hardware and software and that of their competitors'.

Which brings us back to Java. As we move into a world that's about to have many more islands of computing, we may at last have a platform that bridges them. If the various gods behind the curtain don't create a host of competing virtual machines and extensions that recreate the nonstandard world of Unix, we'll get that platform. But to do so, we may have to pull back the curtain and force those squabbling gods to keep to the promise of Java. Or live dangerously.

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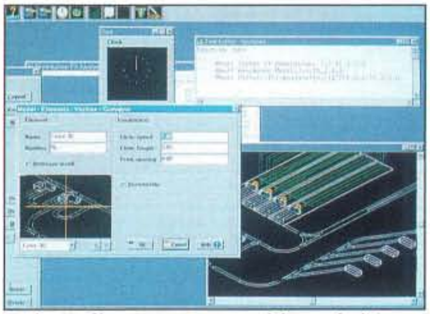

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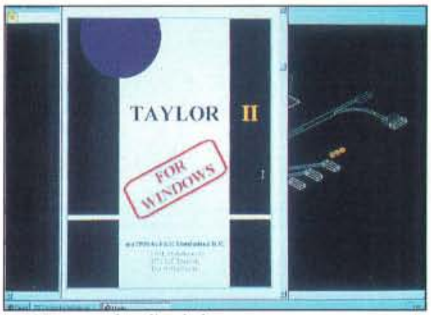

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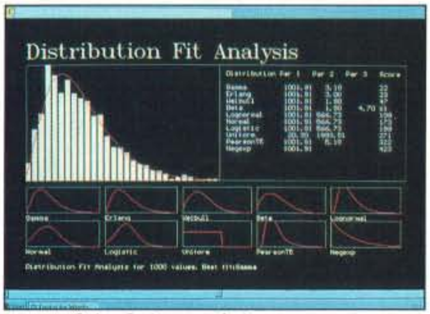

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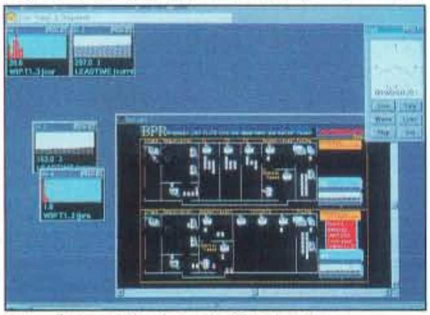

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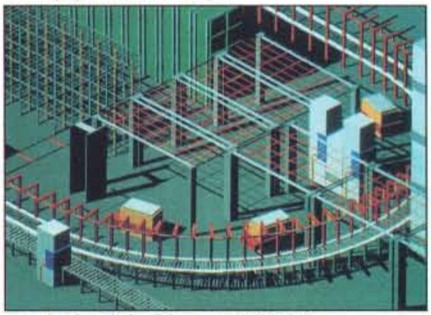

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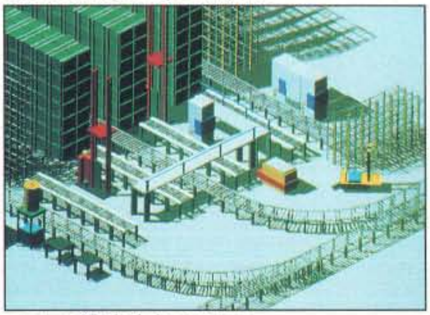

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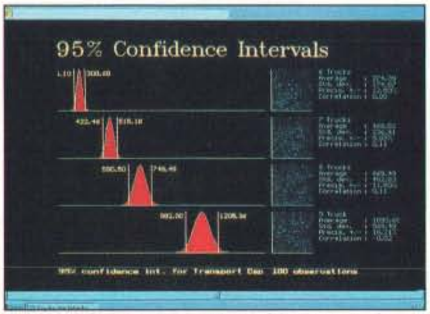

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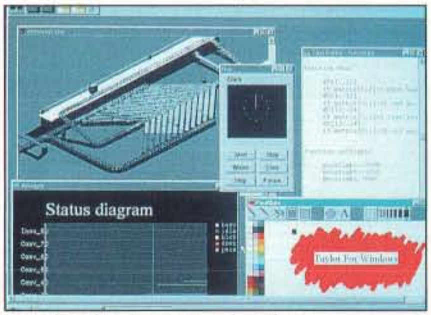

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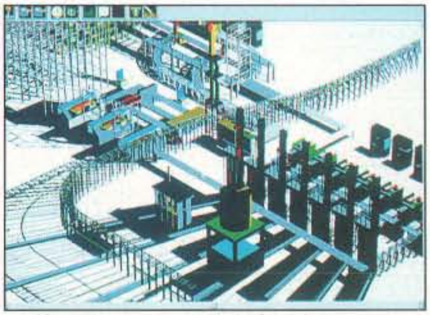

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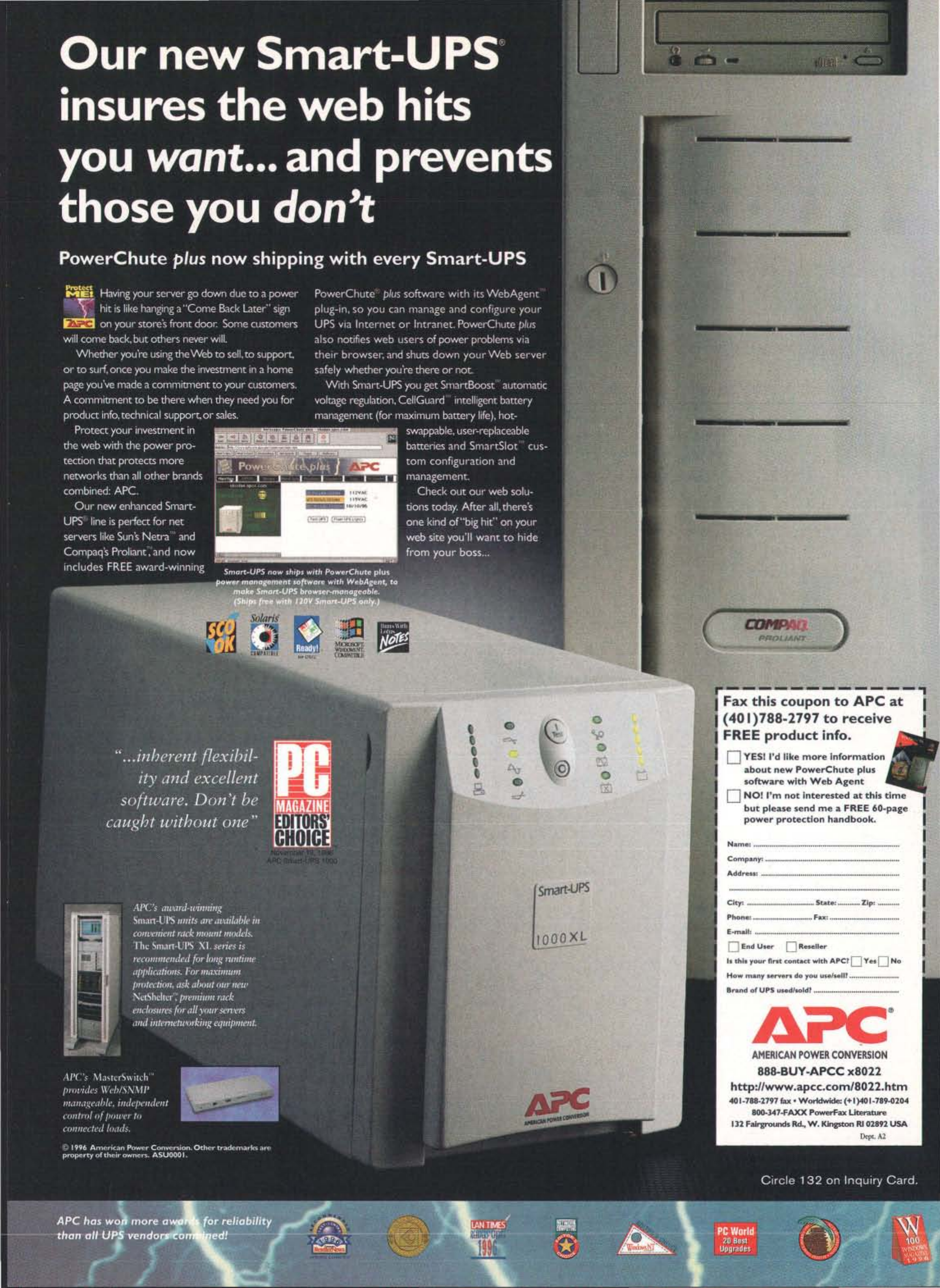

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WebNFS at the Limit

"A File System for the Web" (Core, November 1996) was excellent, and the layout of the protocol diagrams, with each protocol having its own horizontal displacement, is brilliant. Thanks, too, for stressing the limits of WebNFS. It's important to set expectations correctly: WebNFS is a file-system technology that has some overlap with HTTP, but it's not an HTTP replacement.
Brent Callaghan
brent.callaghan@Eng.Sun.com

Reading "A File System for the Web" makes me curious about your impression of CIFS, the counterpoint to WebNFS. Does it have the same limitations as WebNFS?
Jeff Tanner
jeffta@ccintnet.wrq.com

CIFS, the Common Internet File System, is a modification of Microsoft's Server Message Block (SMB) protocol that can be used over the Internet from a Web browser. One major difference between CIFS and WebNFS is that with CIFS, both the server and client maintain state information; with NFS, only the client maintains state.

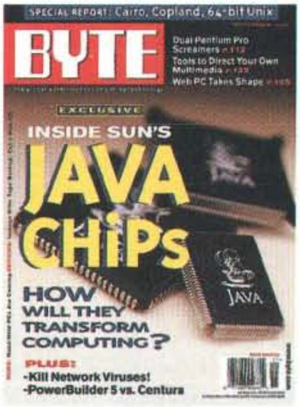
If the TCP connection supporting a CIFS session fails, then the CIFS session will likewise fail, and data may be lost. NFS RPC is independent of the TCP connection carrying it, so the TCP session can simply be reestablished with no more harm than a connection delay.

In a LAN environment, where connectionless transports are acceptable and often perform better than TCP, CIFS should be resistant to temporary network disturbances. CIFS also supports features that NFS lacks, such as network printing, streaming devices, and built-in file locking.

Internet hype aside, the big money for software vendors is in the intranet (i.e., LAN) market. Since PCs are the majority LAN client, and many already use Microsoft's SMB protocols, CIFS should do well in that area. In the Internet environment, WebNFS should be more robust in the face of unreliable modem connections and dynamic IP-address assignments. For more on CIFS, see http://samba.anu.edu.au/cifs/ or http://www.microsoft.com/intdev/cifs/.
—Bob Friesenhahn

The Real 64-bit OS

I was disappointed to see no mention of Linux in "Unix Leads the 64-bit Charge" (November 1996). Linux for the Digital Equipment Alpha has been available for over a year, is rock solid, and is 64-bit through and through. It's also worth noting that the developers in the Linux/Sparc project are aiming for a 64-bit implementation on the UltraSparc. There's a good possibility that it will be available before Sun produces a true 64-bit Solaris.
Christopher Horn
chorn@warwick.net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It seems unlikely for Unix to lead the 64-bit charge when AS/400 is already there. While OS/400 (the OS) is mentioned several times in "Unix Leads the 64-bit Charge," AS/400 (the hardware system product) is not, and neither one is put into any context. If OLTP, data warehousing, and content management are interesting to BYTE's readership, then a full description should be of real interest.

While the Unixoids have been playing in the 64-bit space for a while, there are few real 64-bit applications to exploit it. C (and C++) implementations are not truly portable and require significant recoding to work correctly in a 64-bit address space, let alone fully exploit it. The largest volume of 64-bit software, by any measure (e.g., lines of code, fully enabled applications, and systems deployed), is written in RPG and COBOL and runs on the AS/400.
Steven J. Munroe
SJMUNROE@aol.com

At the Crossroads

What Mark Schlack seems to miss in his excitement over Sun's Java chip ("Computing Crossroads," November 1996 Editorial) is that we've been here before. We've seen custom C chips, Ada chips, and even BASIC chips. In theory, a chip designed to run a particular language should outperform a general-purpose chip, such as the Pentium; in reality, however, this isn't true. The strong optimizing compilers we now have for C++, with the few tweaks Intel has made in the instruction set, deliver performance that I bet will meet or exceed that of any custom Java chip.

True, portability is a con-

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cern—for Sun and Apple—but not to the majority of users who already have Intel chips in their machines.

Java may become a standard for Web programming, but to achieve acceptable performance, it will have to be precompiled with multiple-instruction-set versions on the server. Your browser will request the instruction stream that corresponds to your local processor, and that's what will run on your platform. In that world, a Java chip has no real advantage over the existing choice of RISC and Intel chips.

Mike Kelly
mikekelly@msn.com

I agree that Sun must demonstrate—not just assert—that the Java chip delivers the needed performance. I think you miss the boat, though, when you say that portability is a concern to Sun and Apple but not to the majority of users. When business managers scream for applications that can leverage the Internet to deliver a service or product anywhere, on any kind of customer computer, portability is no longer a theoretical issue but a pressing concern. While prior technologies may have attempted similar things, they didn't exist in the context of today's need for pervasive computing in a heterogeneous, networked world. Meanwhile, for more on Java as a software platform, see "Today the Web, Tomorrow the World" on page 68.
—Mark Schlack,
editor in chief

The Egg, VMS, or NT?

I appreciated "VMS: Alive and Well" (Core, November 1996), but author Ben Smith had his facts reversed when he stated that "VMS has incorporated many of NT's data structures and design elements." Dave Cutler was the chief architect of NT; before that, he was employed by Digital Equipment as one of the original architects of VMS. In fact, many of NT's internal data structures resemble those of early versions of VMS. NT owes a lot of its success—present and future—to its VMS heritage, not vice versa.

Glenn Carr
gcarr@lgc.com

Actually, it has worked both ways. NT can be said to be a descendant of VMS in some respects, but the point I wanted to make is that VMS has now had to adopt many of NT's structures in order to coexist with it and profit from its growth. NT has drained off some of VMS's potential, as did Unix.
—Ben Smith

Help Yourself

The real need with respect to user help ("Self-Help Software to the Rescue," October 1996 Bits) isn't for online databases of answers to frequently asked questions. Nor is it for software to automatically fix bugs. Many of us can fix problems with wrong file types, application clashes, and missing or replaced DLLs. All we need are decent error messages. Message boxes that tell me an error has occurred and ask me to click OK are *not* OK. Message boxes that present an error code with nowhere to look up that code are just bits blowing in the wind. I wouldn't mind giving disk space to application bloat if it was spent on decent error messages that allowed me to diagnose and fix the problems on my machine.

Glenn P. Davies
gdavies1@ent.agt.ab.ca

CLV Clarified

Thank you for the informative "CDs for the Gigabyte Era" (October 1996). However, you mention that for CLV to maintain a constant bit rate, the rpm has to be increased as the drive reads the inner tracks. Shouldn't that be the opposite? Are the pits evenly spaced on the disc?

Marc Y. Paulin
markus@nbnet.nb.ca

It helps to remember that CLV stands for constant linear velocity. Because the inner tracks are shorter than the outer tracks (and because the pit spacing—which must fall within very tight parameters—is constant), they contain less data. Rather, the laser sees less data during a revolution of the disc. Therefore, the drive has to spin the disc faster, exposing more pits to the laser, to maintain a constant bit rate on the inner tracks.
—Tom R. Halfhill,
senior editor

The Cost of NCs

Your review of the HDS @workStation ("X Terminal + Browser + Java = Web PC," October 1996) shows that a network computer (NC) that's acceptable to a user with enough RAM, a decent monitor, and so forth would cost about the same as a PC. Existing office applications suites are network-aware and can be installed on a server, thereby reducing licensing and support costs. Changing to NCs with browser-based front ends and running server-based Java applications will make little difference in the cost per user.

Then there's the Internet. Like most dial-up users, I won't have access to inexpensive high-capacity bandwidth for ages. A sure way to make me lose interest in a site is to force me to wait 2 or 3 minutes while a Java-based home page builds up. I'm even less interested in waiting 20 minutes for a VRML-based home page to complete. I want to see changes that bring about more choice and better applications, but the credibility of the new technology might be damaged by overoptimistic comments on cost savings and overuse of the technology in inappropriate situations.

Howard Robinson
clippertrading@msn.com

NCs don't need hard disks, CD-ROM drives, floppy drives, extra slots, or a host of other things. Flash ROM and some RAM is enough for a minimal setup. So, NCs can be less expensive. In addition, running an office network isn't as easy as simply buying an office software suite. Users inevitably install their own software; eventually a service technician has to go in and diagnose conflicts individually.

Many businesses also prohibit their employees from downloading software because of fear of viruses. Java is more secure than the old system, and it's also more secure than floppy disk sneakernet. Its garbage collection can also lead to fewer memory management bugs.

In any case, it doesn't really matter whether you download the software as Java applets, EXE files, or COBOL code. The time required is similar, but Java, unlike

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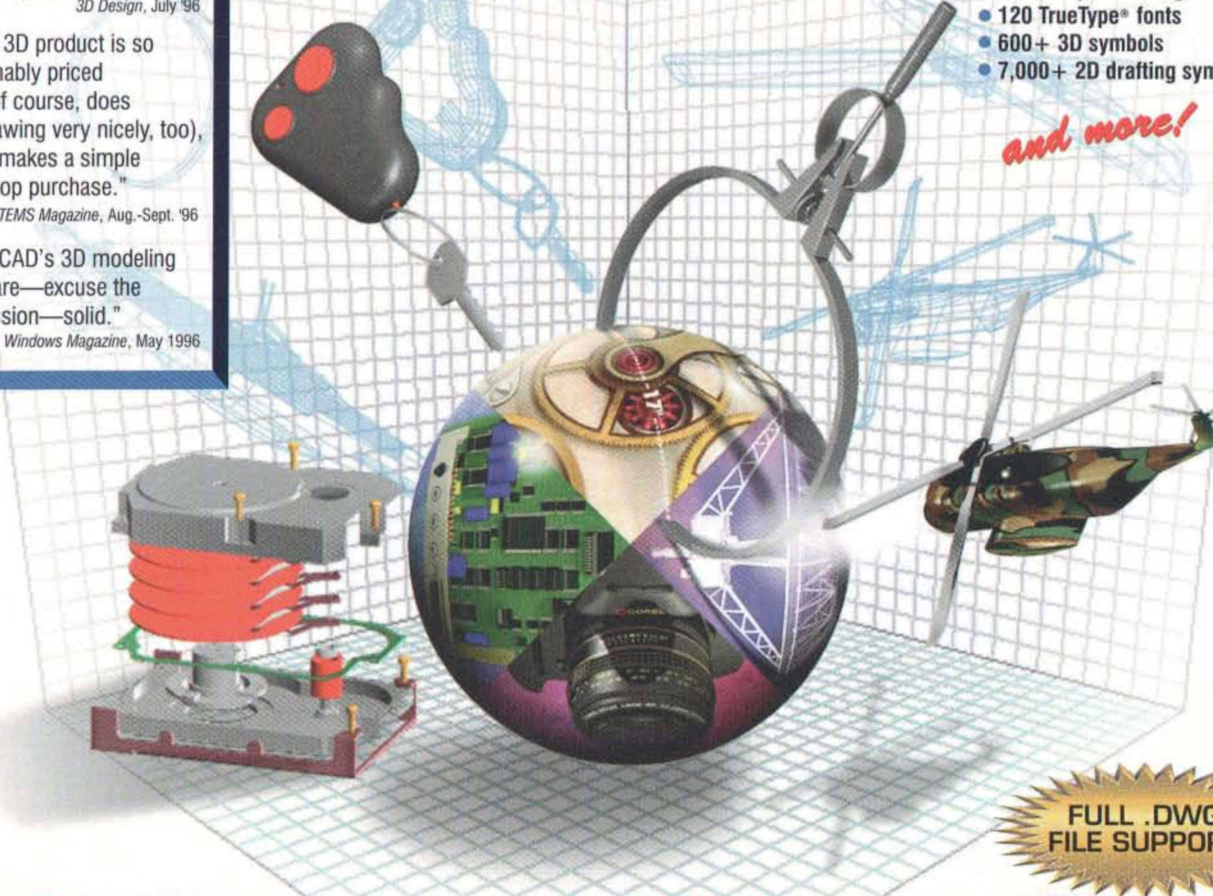

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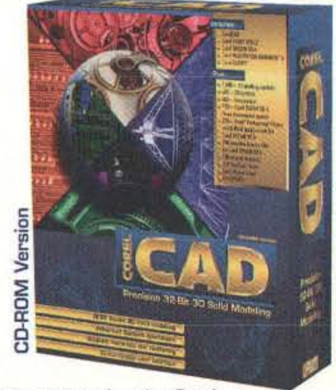

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—Peter Wayner

FIXES

The correct e-mail address for Visage Development, which was mentioned in "Security Gets a New Face" (October 1996 Bits), is bvisick@cix.compulink.co.uk.

Due to an editing error in "Photo Quality Arrives for Low-Cost Printers" (October Bits), we neglected to mention that almost all of Canon's new line of color ink-jet printers (including the BJC-240, BJC-4200, and BJC-4550) take optional photo-quality ink cartridges (which cost $37 to $42). Only Canon's BJC-620 model, which prints at 720 dpi and doesn't require the photo inks, does not take the optional cartridges.

In our review "Real-Time RAD" (November 1996), we erroneously referred to Microtec's VRTX real-time OS as Vertex.

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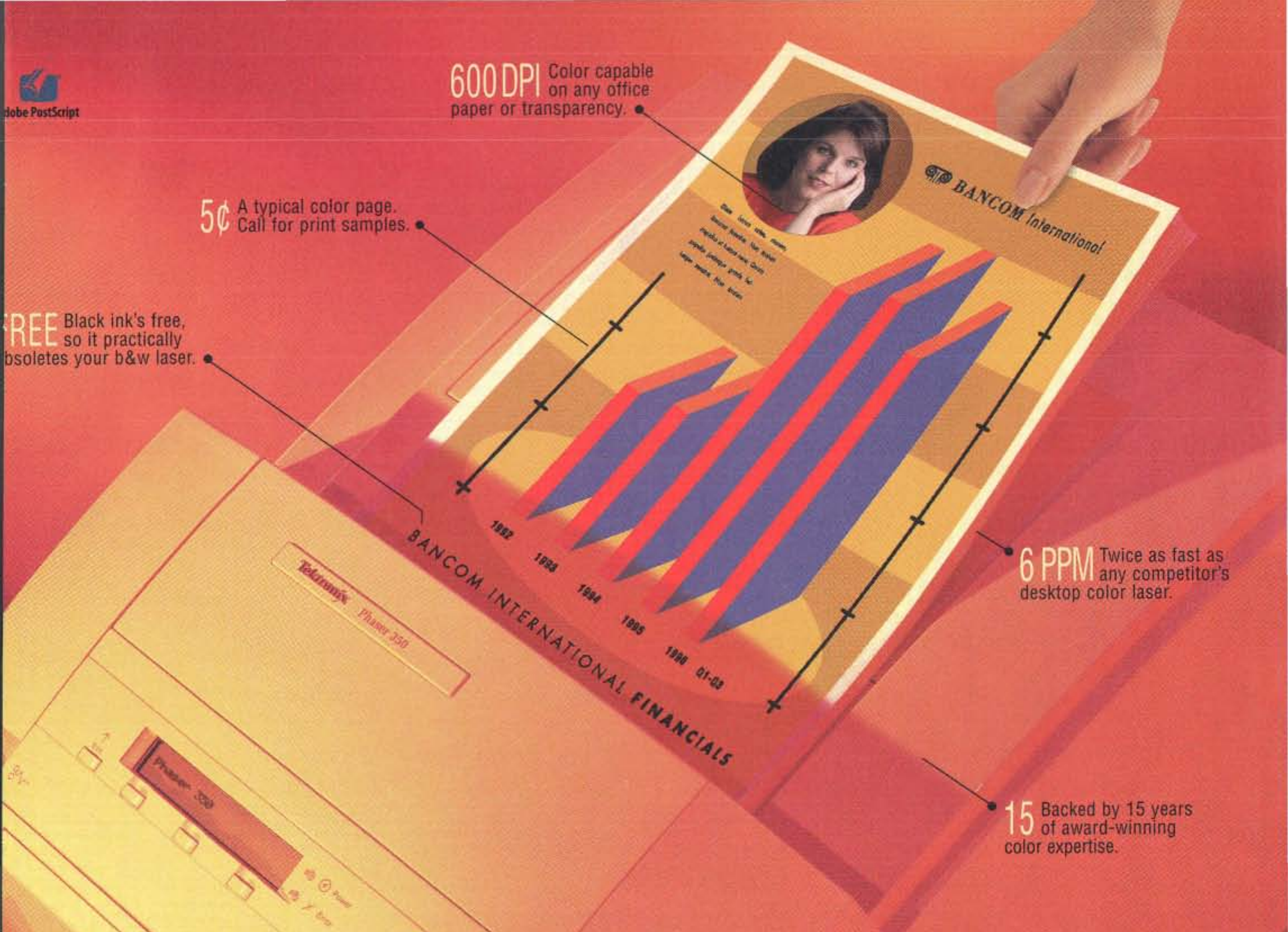
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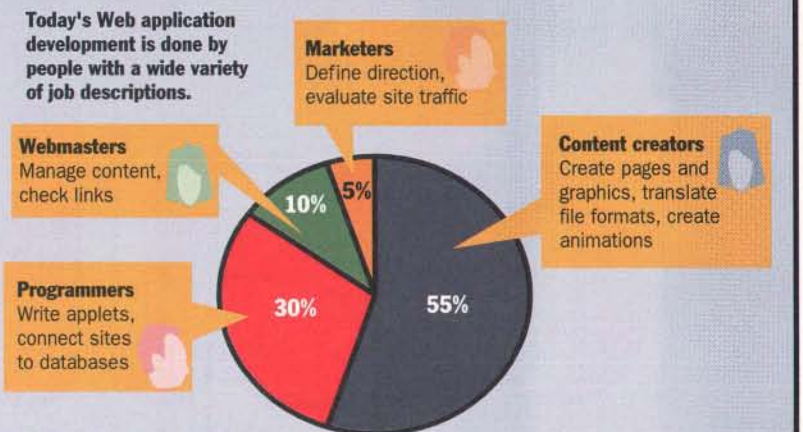
Web Tools Will Converge

Better tools are coming that address all the needs of an enterprise Web site application.

Help is on the way for Web site development teams frustrated by inferior tools that don't work well together. But before that happens, expect a lot of consolidation in the market. The fundamental difference between old-style, client/server applications and today's dynamic Web sites caught developers by surprise, and the first generation of tools didn't adequately address Webmasters' needs. New tools, and even new tool categories, are appearing at a rapid clip. But while many of these tools excel at a specific function, they still need to improve in their ability to integrate with each other.

"Today, Webmasters are working from 8 a.m. to 10 p.m. shuffling files around and tracking down content when they should be formulating long-term strategy," says Josh Bernoff, an analyst at Forrester Research (Cambridge, MA) who covers the Web tools market. "The tools are improving. But as sites get bigger and more complex, the need for these tools to work better with each other will increase."



Web Development Roster for a Typical Team

Source: Forrester Research (617-497-7090 or http://www.forrester.com) interview with 52 Webmasters of sites offering corporate information, consumer content, or Internet commerce, plus 10 Web development houses.

A fundamental difference between old-style applications and dynamic Web applications is who creates them and the pace at which new applications are introduced. Before, applications were built by teams of programmers, and months or years could pass before the release of the next version. But a survey conducted by Forrester (see the chart above) shows that today's Web development team includes positions in a company ranging from programmers to marketing personnel. "Web applications are fundamentally different from any other applications that are getting built today," says Rowland Archer, chief operating officer at HAHT Software (Raleigh, NC), a maker of application development and deployment tools. "As the Web makes the move from an advertising medium to an application platform, this difference will matter even more." Tools geared toward programmers or creators of content just don't address the big picture by themselves.

This is why analyst Bernoff predicts vendors will increasingly adopt a strategy of integrated tool suites that address Web developers' diverse needs. Today,

geek mystique

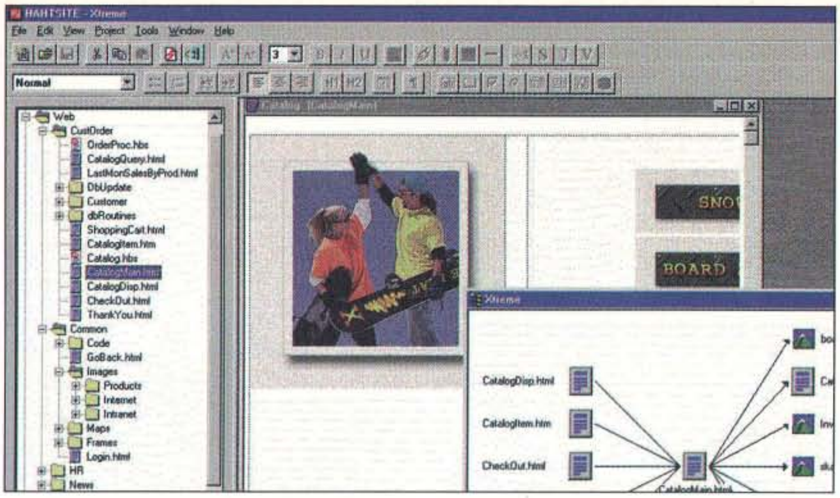
Geekette Power

Although the computer technology realm has more than its fair share of men, women may be geekier than you think. According to a survey of women who live in a household that has either bought a PC in the past two years or is planning to buy one in the next 18 months, 66 percent had significant input and 21 percent had some input in computer-related purchases at home. The survey, performed by the research company IntelliQuest, questioned 1500 randomly selected women (ages 18 to 55) in the U.S.

- **Almost half (48 percent) said joint household funds were used, while 24 percent said they personally paid for the PC.**
- **Of those surveyed, 69 percent agreed somewhat or strongly with the statement that they feel good about themselves when using complicated technology. And 68 percent said they would hate to be without their PC.**
- **Women don't feel like they are getting an equal shake from salespeople: 51 percent agreed that women receive less respectful treatment from sales persons than men do.**

developers can pick from a variety of tools that address certain aspects of a Web site's needs. For example, Astra, from Mercury Interactive (Sunnyvale, CA), addresses site analysis, usage tracking, and link management. Ringmaster, from Ikonic (San Francisco), coordinates content among Webmasters, editors, and authors.

Rick Fleischman, senior product manager for tools at Netscape (Mountain View, CA), says these tools generally have one of three goals: creation of core page elements such as graphics and Java or multimedia applications; site assembly that integrates content and these various applications and provides functionality like live database access or electronic commerce; and site/content management and deployment.



HAHT Software's HAHTsite 2.0 typifies new Web tools that integrate a wide variety of functions.

Each category has tools with capabilities that cross over into another category, however. For example, Microsoft's FrontPage 97 offers WYSIWYG page layout tools, but the program also has site management and content creation tools (Image Composer that comes with the FrontPage Bonus Pack). The site-assembly category has the widest variation, ranging from WYSIWYG page-layout tools to enterprise application-deployment tools. HAHT Software's HAHTsite 2.0 is an example of this latter category. It has a Windows-based integrated development environment that incorporates other vendors' tools; its application server runs on multiple operating systems and can integrate with existing third-party client/server platforms such as SAP.

Forrester's Bernoff predicts that tools will continue to improve this year and says you can also expect the currently fragmented market to consolidate into partnerships or around platforms. One such platform is Netscape One, an open network environment based on publicly defined standards that lets developers create tools that work with each other. Netscape and Silicon Graphics (SGI, Mountain View, CA), which already offer the LiveWire and Cosmo suites of tools, respectively, will also improve their offerings, either by developing new products or by acquiring products from other companies. Microsoft, which is developing Internet Studio, will play a major role in the suite trend, and so may Adobe and Macromedia. Adobe will probably focus on creating tools that integrate with Microsoft's and Netscape's environments, and Macromedia will concentrate on video, interactive Virtual Reality Modeling Language (VRML), and animation, Bernoff says. SGI's current focus on its own hardware may turn away potential customers who want Mac or Windows solutions.

In the meantime, developers can seek relief from tools that are improving. Builders of database-connected sites should check out products from HAHT, NeXT (Redwood Shores, CA), and others that avoid Common Gateway Interface (CGI). It's also smart to budget for constant tool turnover to avoid getting locked into products as vendors' fortunes ebb and flow.

The good news about all these bewildering options is that competition among vendors is fierce. "Prices will come down, and performance and features will escalate at a much faster pace than you've ever seen before," says John McCrae, marketing manager for SGI's Cosmo suite. "Customers will end up with better, less expensive products and better content."

–Dave Andrews

yeah, but...

September 17, 1996, and the National Public Telecomputing Network (NPTN) starts its autumn by filing Chapter 7 bankruptcy. So what? Another day, another company bites the big one.

Yeah, but NPTN (http://www.ntnp.org) was the tallest tree in the Free-Net forest. NPTN was leading the way in creating community-run systems that let people get free access to the Internet.

Today anyone can hook up to the Internet for as little as $15 a month; so who cares?

Yeah, but in rural areas, Internet service providers can be hard to find. Free-Nets give people from Nova Scotia's Cape Breton Community Network (http://highlander.cbnet .ns.ca) to Montana's Big Sky Telegraph (http://macsky.bigsky.dillon .mt.us) a chance to keep up with the rest of us. Urban sites let people whose computer equipment consists of a discarded XT and a 2400-bps modem hook onto the Net. The Free-Net march may continue, but with the flagship gone, the entire movement has been shaken. NPTN reminded us that the Internet is about people, rich and poor, city and country, communicating.

–Steven J. Vaughan-Nichols

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Netcards Coming to America

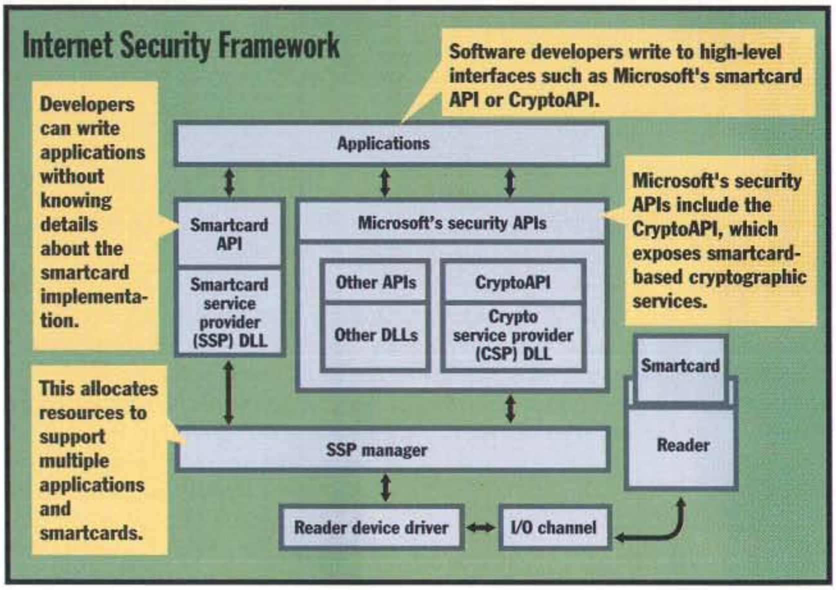
A marvel of technology that enjoys widespread use in Europe, and to a lesser degree Canada, may finally gain acceptance in the U.S. The PC/SC Workgroup, supported by the Smart Card Forum and made up of PC and smartcard companies, recently announced its intention to develop open standards allowing the integration of smartcards with PCs. The workgroup includes Schlumberger Electronic Transactions, Microsoft, Hewlett-Packard, Siemens Nixdorf Informationssysteme AG, and Bull CP8.

While the use of smartcards with PCs is nothing new, an open standard for interoperability between smartcards and PCs is. "The idea is to offer the same type of interoperability between smartcards and PCs as already exists with printers," said Jean McKenna, president of the Smart Card Forum and vice president of Payment Technologies at Visa International.

At press time, the workgroup planned to release its standard in the fourth quarter of 1996, setting the stage for product announcements, including new smartcard readers from Schlumberger, the expected bundling of smartcard readers with HP PCs in early 1997, and support for the standard under Windows.

In the U.S., isolated implementations of smartcards have already occurred. Visa Cash, an electronic-cash card, proved successful at the Atlanta Summer Olympics. However, the U.S. may lack the marketplace infrastructure and consumer buy-in to make stored-value cards, used at point of sale, the dominant smartcard application in this century. "It will be at least the year 2001 before there is sufficient momentum and infrastructure to allow for the widespread implementation of stored-value smartcards in the U.S.," according to David Weisman, analyst for Forrester Group (Cambridge, MA).

Smartcards will initially gain momentum from corporations looking to provide secure access for employees to corporate networks from the office or the home. The use of these cards on the Internet (hence the term Netcard) also forces a paradigm change. "With the introduction of universal standards for smartcards and readers, you no longer authenticate your terminal. You authenticate the individual," said Michel Roux, general manager, Multimedia Business Division of France-based Gemplus, a developer of smartcards and readers.


Internet Security Framework
Software developers write to high-level interfaces such as Microsoft's smartcard API or CryptoAPI.
Developers can write applications without knowing details about the smartcard implementation.
Applications
Smartcard API
Smartcard service provider (SSP) DLL
Microsoft's security APIs
Other APIs
Other DLLs
CryptoAPI
Crypto service provider (CSP) DLL
Microsoft's security APIs include the CryptoAPI, which exposes smartcard-based cryptographic services.
Smartcard
Reader
This allocates resources to support multiple applications and smartcards.
SSP manager
Reader device driver
I/O channel

Microsoft's API for smartcards insulates software developers from having to become cryptography experts.

This is where Microsoft comes in. Its 32-bit Windows APIs include a generic interface for smartcard reader technology (see the figure) that adheres to upcoming PC/SC standards, as well as to the ISO 7816 specification.

Once the technology exists in the home, or on the notebook, people will be enticed to take advantage of it for personal use.

–Daniel Coyle

future watch

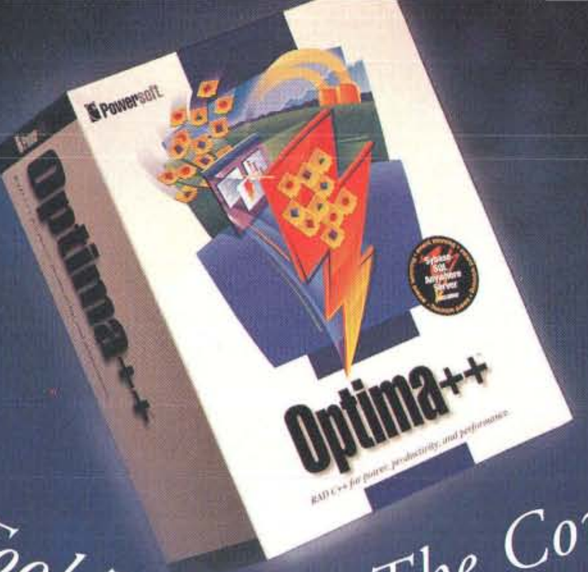
Coming This Year: Virtual Receptionists

Tired of waiting on hold to schedule appointments? Relief is on the way in the form of a new Internet calendaring and scheduling standard. This standard, currently still a work in progress, will let you, where access is permitted, browse other people's calendars, schedule meetings, and view the open time slots that a person or an organization has.

Vendors such as Lotus, Campbell Services, and On Technology offer products that let you check schedules using a browser; for example, Lotus's Organizer 97 Web Calendar server application lets you access Organizer schedules over the Internet. But Lotus's program and alternatives don't universally work with calendar programs from other vendors. "The number of people using PC calendaring is about one-third the number who use PC-based e-mail," says Anik Ganguly, a longtime advocate of calendar interoperability. "Why? Because calendars lack compatibility, unlike e-mail, which has numerous gateways and a common backbone."

That's where standards such as the Versit consortium's vCalendar, the Internet Calendar Access Protocol (ICAP) originally proposed by Lotus, and others come in. Once the Internet Engineering Task Force blesses a working standard for calendar interoperability, possibly by this summer, you'll start seeing products that talk to each other.

–Dave Andrews



"A RAD Tool That Aces The Competition"

Peter Coffee, PCWeek, June 10, 1996

"Optima++ marks a leap forward over traditional C++ tools." *Rich Dragan, Windows Sources, June 1996*

"Powersoft's new development tool makes creating corporate applications with C++ an optimal experience." *Dan Rogers, Software Development, September 1996*

"Optima++ is a powerful product that combines the ease of use of VB's component metaphor with the speed and power of C++." *Steve Jackson, Visual Programmer++, September 3, 1996*

"Powersoft has scored a home run." *Dan Rogers, Software Development, September 1996*

"Optima++ represents a breakthrough in visual programming not only for C++ developers, but for all users of fourth-generation language (4GL) client-server lopment tools." *Rich Levin,*

"Superb integration; innovative component-oriented tools; superior execution speed; nonproprietary language." *Peter Coffee, PCWeek, June 10, 1996*

"With Powersoft's Optima++ visual tool, C++ development for Windows has never been easier." *Sean Gallagher, Information Week, May 6, 1996*

"A C++ Tool That Cures VB Envy" *Rick Grehan, BYTE, October 1996*

"Optima++ provides direct ODBC support, meaning classes and bound controls call the ODBC API directly, without an intermediate layer such as VB's Jet engine or Delphi's IDAPI." *Steve Jackson, Visual Programmer++, September 3, 1996*

"[Optima++] puts the fastest compiler that we've found to date into an environment that is both approachable and productive." *Peter Coffee, PCWeek, March 18, 1996*

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PCWEEKLABS ANALYST'S CHOICE JUNE 10, 1996 Optima ++ Developer 1.0

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Wireless PDAs Will Proliferate

Mobile phones are on the verge of experiencing the same sort of growth and options that personal computers did years ago. Not only are there new products on the horizon, but new parts of the radio spectrum are coming into play thanks to the deregulation in the U.S. of the airwaves and the subsequent auctions by the Federal Communications Commission. Digital wireless offers numerous advantages over today's analog system, including relief from congestion in urban areas, support for voice and data, and better security through encryption.

One of the most innovative of the new breed is the Nokia 9000 communicator, which offers far more than just wireless voice communications. The Nokia, which uses the Global System for Mobile Communications (GSM), looks like a conventional phone but can open up to reveal an inside that looks more like a small palmtop computer. In this mode, the Nokia can be used to send and receive e-mail messages that you can type on the small keypad. You can also send and receive messages to and from a fax machine. In fact, the Nokia 9000 not only looks like a palmtop computer when fully opened but also includes some functions that are more typical of a hand-held organizer. A calendar, a notepad, an address book, and a calculator are built in.

Beyond this, the Nokia 9000's capabilities include Internet access, although the gray-scale 640- by 200-pixel LCD doesn't deliver the type of spiffy Web graphics you may be used to. Still, the ability to log on from a device that weighs less than a pound is pretty slick.

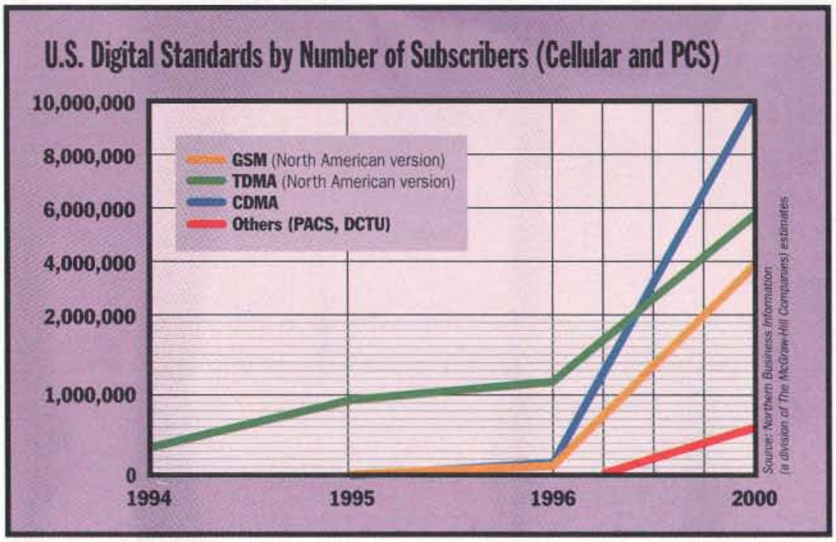
The Nokia 9000 Communicator is an impressive product (in fact, it won BYTE's Best of CEbit award last year). However, even if you're prepared to spend roughly $2000 to buy one, you'll have to wait. The phone is available in Europe but won't be rolled out in the U.S. until sometime later this year, partly because its communications network is not fully in place.

In fact, the larger issue for buyers may be whether GSM and the rest of the alphabet soup of personal communications service (PCS), including CDMA (Code Division Multiple Access), TDMA (Time Division Multiple Access), PACS (Personal Access Communications Systems), and DCTU (Dominant Certified Telecommunications Utility), represent a fractured market that make them an unwise buy. According to Bukasa Tshilombo, research manager, world wireless markets, for Northern Business Information (New York City), buyers shouldn't worry. According to Tshilombo, by the year 2000, GSM will enjoy broad coverage in the U.S., as it does in Europe today. However, don't expect a device that supports the U.S. version of GSM to automatically work in Europe. U.S. GSM phones will operate at a different frequency than GSM devices in Europe.

Tshilombo predicts that users in North America will soon have numerous wireless options. "Over time, all of these various options should offer reasonable price and coverage," he says.

That's certainly good news for those attracted by the charms of the Nokia and similar PCS-based phone/communicators. Clearly, talk alone isn't going to be enough in the untethered world.

– Jon Pepper


U.S. Digital Standards by Number of Subscribers (Cellular and PCS)

Source: Northern Business Information (a division of The McGraw-Hill Companies) estimates

A wealth of wireless communications options will be available in the U.S., according to NBI's forecast.

Bug of the Month

HTML Stymies Netscape Navigator

Even the relatively simple Hypertext Markup Language (HTML) can be used to do bad things. Richard Smith, president of Phar Lap Software, a vendor of programming tools, discovered a way to disrupt Netscape Navigator using plain old HTML.

First, create an HTML file named BOOM.HTM whose contents include:

```
<body>
<img src="file:///com1
<img src="file:///com2
<img src="file:///com3
<img src="file:///com4
<img src="file:///aux
</body>
```

Compose an e-mail message that contains BOOM.HTM as an attachment and send it to someone. When the recipient reads the e-mail message with the Netscape Mail program, Navigator locks up when the mail program attempts to display BOOM.HTM.

The lockup occurs because Navigator is trying to read a GIF file from serial ports COM1 through COM4. Because no data is coming through those ports, Navigator hangs. And when the target device name is AUX, the computer might lock up completely.

Netscape says it fixed the bug with a recent upgrade of Navigator 3.0.

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Welcome to the Real Data Superhighway

North America stands poised to finally enter the age of the true electronic "information superhighway." In December 1996, the 36-kilometer first phase of the Express Toll Road (ETR) Highway 407 was expected to open. Heralded as the world's first fully automated open-road tollway, the system allows commercial traffic to pass through tolls without slowing down or stopping. When phase 2 is completed in 1999, ETR 407 will extend 69 km, spanning the top of metropolitan Toronto and featuring 125 electronic toll points installed at on- and off-ramps.

Each electronic toll point or roadside toll collection (RTC) point operates with in-vehicle transponders, roadside antennae and cameras, and data management systems that record vehicle identity, monitor tollway use, and manage revenue collection. Vehicles without transponders can also use the tollway because digital cameras record rear license plate numbers as the vehicles enter and exit the road.

When a vehicle enters the tollway, its transponder networks via UHF with the RTC. Each RTC utilizes the Slotted Aloha Time Division Multiple Access (TDMA) protocol. (The protocol was originally developed by the University of Hawaii for military applications.) Hughes Aircraft has adapted the protocol for use with its Vehicle-Roadside Communications systems. A technique called *angle of arrival*, which enables the military to pinpoint enemy targets, can also, in a fraction of a second, identify specific transponders at any place and time, allowing for toll collection without slowing down at the RTC. Transponders, developed by Mark IV Industries, are mounted on the vehicle windshield directly behind the rearview mirror. Each has a communications frame of 10 milliseconds and creates a 915-MHz link using active communications and the Slotted Aloha TDMA protocol.

Slotted Aloha provides for concurrent communications at more than 500 Kbps with up to 272 vehicles at a time, regardless of the speed at which they're traveling. This accuracy allows the RTC to identify individual transponders within a fraction of a meter, so even motorcycles riding side by side, inches apart, can be separately identified.

"Equipped with Slotted Aloha, transponders provide 99.99 percent accuracy even in the high-speed, close spacing, and multilane conditions found on tollways such as the 407," says Martin Gray of Hughes Aircraft and project manager for the ETR 407. In addition to 125 RTCs, ETR 407 also includes two toll transaction processors that use asynchronous transfer mode (ATM) technology. These are

Survey

Coordination, Cleansing Most Demanding Data Warehouse Tasks

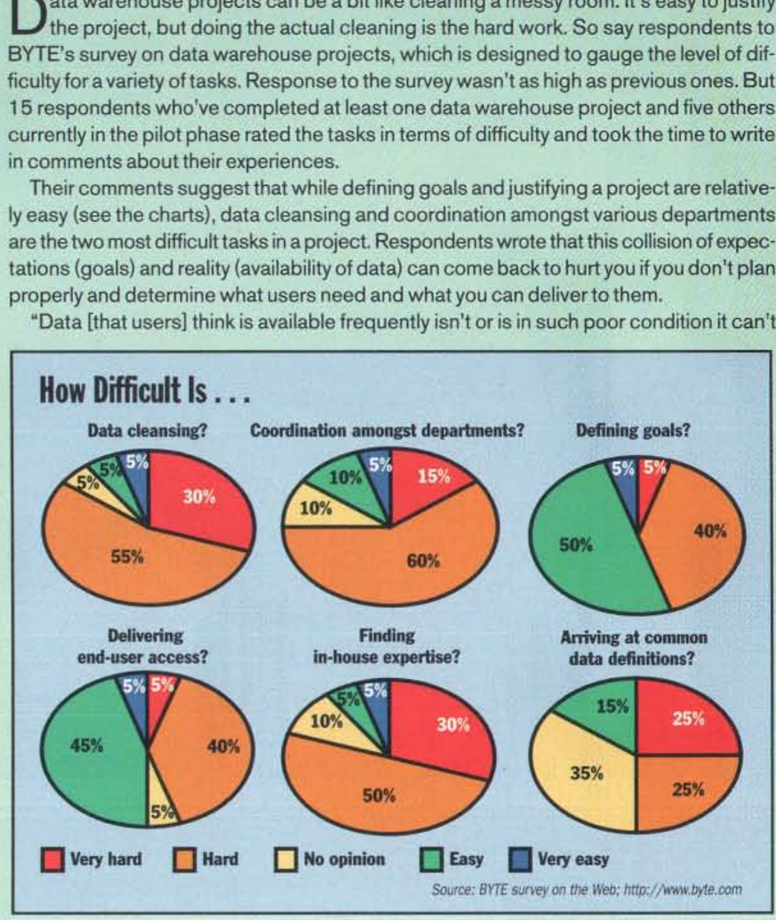
Data warehouse projects can be a bit like cleaning a messy room. It's easy to justify the project, but doing the actual cleaning is the hard work. So say respondents to BYTE's survey on data warehouse projects, which is designed to gauge the level of difficulty for a variety of tasks. Response to the survey wasn't as high as previous ones. But 15 respondents who've completed at least one data warehouse project and five others currently in the pilot phase rated the tasks in terms of difficulty and took the time to write in comments about their experiences.

Their comments suggest that while defining goals and justifying a project are relatively easy (see the charts), data cleansing and coordination amongst various departments are the two most difficult tasks in a project. Respondents wrote that this collision of expectations (goals) and reality (availability of data) can come back to hurt you if you don't plan properly and determine what users need and what you can deliver to them.

"Data [that users] think is available frequently isn't or is in such poor condition it can't be easily used," says one respondent. Several said that warehouse planners should get a strong definition upfront of what data should be in the warehouse and what's available to ensure usable results. Knowing in advance what data is accessible is quite useful, as 60 percent of respondents rated integration with legacy data either "hard" or "very hard."

Along with technical expertise, knowing how to play the political game can help, too, says one respondent. Since coordination amongst various departments is hard, you'll want to ensure that the project sponsor wields a big enough stick to knock down barriers to success.

– Dave Andrews



Source: BYTE survey on the Web; http://www.byte.com

Data cleansing and departmental coordination are the toughest data warehouse tasks, according to a BYTE survey.

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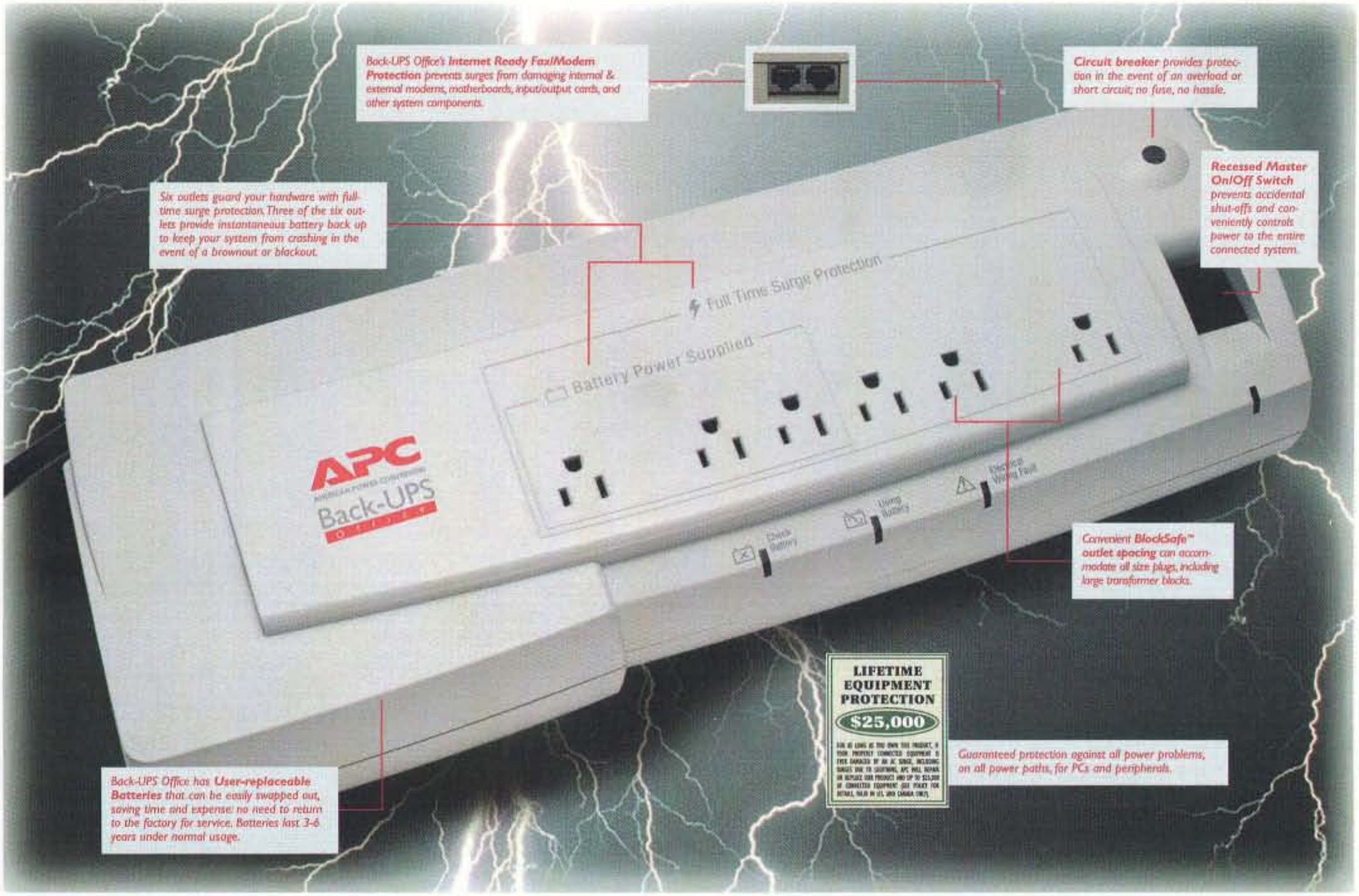

Back-UPS Office's **Internet Ready Fax/Modem Protection** prevents surges from damaging internal & external modems, motherboards, input/output cards, and other system components.

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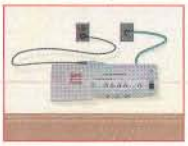

Back-UPS Office's compact design installs easily on desktop, floor or mounts to wall.

Multiple peripherals and data lines to and from your system are vital, but dangerous. Without them, you can't do your job. However, if a power sag makes your modem drop the line while you're downloading from the Internet, or locks your keyboard before you've saved work, you lose time, money and spend another late night at the office to meet your deadline.

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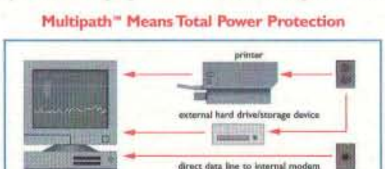
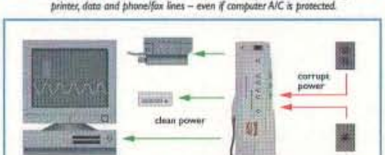

printer
external hard drive/storage device
direct data line to internal modem

Bad power (red) can enter a computer system through multiple paths – eg. printer, data and phone/fax lines – even if computer A/C is protected.



The Multipath™ protection of Back-UPS® Office™ shields your peripherals and guards your computer from bad power on every path, providing clean, safe power (green), to your entire system.

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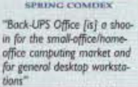

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Data			•
Phone			•
Total Outlets	7	2	6
Number of Block Outlets			2
Protection from			
Surges	•	•	•
Spikes	•	•	•
Blackouts		•	•
Brownouts		•	•
Overvoltages			•
Typical Runtime in Minutes			
with Pentium 100 w/15" monitor		10	10
Battery backup for			
PC		•	•
Monitor		•	•
Storage Devices/Zip Drives			•
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Fax/Modem	•		•
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Internet or Network			•

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located in a central administration center with a revenue management system.

Information collected by RTCs passes through fiber-optic cable to the transaction processors via an ATM network. Computer and imaging technology developed by Hughes matches the toll-road entry for each vehicle with the corresponding toll-road exit. This data is then relayed to the revenue management system, which handles all customer billing and collection functions.

ETR 407 is the result of a public/private partnership. Members include the Ontario Ministry of Transportation, Hughes Aircraft of Canada, Bell Canada, Bell Sygma Telecom Solutions, Mark IV Industries, and Canadian Highways International Corporation.

While ETR 407 is the world's first fully automated toll road, electronic toll collection is not unique to Ontario. In 1987, several toll agencies in the Northeast Corridor spanning New York, New Jersey, and Pennsylvania began investigating the potential of electronic toll collection. In 1991, seven toll facilities within the Northeast Corridor joined to form the E-Zpass Interagency Group (IAG). Accounting for almost 40 percent of all U.S. toll transactions and 67 percent of all U.S. toll revenues, the IAG wants to develop a cohesive, regionally compatible electronic system to streamline toll collection and to offer customers a transparent method.

Upon evaluation of several technologies, IAG is now implementing transponder technology from Mark IV Industries. Over the next five years, IAG members plan to install E-ZPass technology at approximately 200 sites, covering approximately 1500 miles of tollway, four tunnels, and 12 major bridges. The success of IAG's efforts represents the most significant move toward standardization of electronic toll collection in North America. Discussions between IAG and the Province of Ontario have taken place; however, at press time, Ontario hadn't committed to join the agency.

While it is the strength of the technology players that has driven regions such as the Northeast Corridor and Ontario to choose similar systems, much work has to be done to provide drivers with a continent-wide standard for toll collection. But the first steps have been taken toward a more efficient way of collecting revenue from busy travelers. **–Daniel Coyle**

Book Reviews

Net Metaphors

Are the metaphors we use to describe the Internet a danger to its development? Mark Stefik, a scientist at the Xerox Palo Alto Research Center (PARC), believes they are, and he makes a convincing case in *Internet Dreams.* Stefik has compiled a powerful collection of essays, from Vannevar Bush's seminal "As We May Think" from 1947 to more current works. Clever juxtapositioning of the essays wrapped in the author's insightful commentary paints a telling picture: The Internet is unique, yet the policies that shape its design and use are often influenced by the metaphors that we ascribe to it. The rules that govern, say, telephone communications probably won't translate well to the Net.

Why is this a big deal? Although metaphors are useful for explaining the Internet to novices, they mask subtle but important differences. Lawmakers, notoriously uneducated about the on-line world, might impose ill-fitting regulations. Companies might try to adapt existing but inappropriate commerce models to it. Most important, as these metaphors become more and more entrenched in the public subconscious, we lose sight of the vision that Stefik and his chosen essayists outline for the Net.

Stefik organizes the book into four parts, each representing a different metaphor. These include the digital library, electronic mail, electronic marketplace, and the digital world. The essays show the evolution of the metaphor, as well as present a vision of the Net's potential. For example, philosopher Scott D.N. Cook tackles what he calls the Gutenberg Myth, explaining that the invention of the printing press was only one of the events that, over centuries, brought about mass literacy. Laura Fillmore tells what it's like to be an on-line publisher.

Stefik introduces each essay, then puts it into perspective with an ending commentary. *Internet Dreams* is not just a philosophical argument, therefore, but a valuable history (and prehistory) of the Net. In fact, no other book that I'm aware of portrays the philosophical development of the Internet with such depth and perspective.

The book carefully explains where each metaphor fails, but Stefik doesn't really offer any new metaphors, which I took to suggest that it's time for us to accept the Net for what it is. Once we discard that old baggage, we can move on.

Most of the essays were written for an academic or professional audience, and the writing is sometimes dense and dry. Stefik assumes that his readers will be experienced Net users, yet the book repetitively explains some of its most basic aspects. But don't let these nits stop you from reading this book. Stefik brings clarity, focus, and historical perspective to the Internet.

–Michael Nadeau

Life in the Outernet

There's a brave new world out there where you can access thousands of magazines and newspapers, chat with friends, make new acquaintances, and receive mail free of charge (albeit only six days a week). Sound familiar? It's the Outernet, the world beyond our computer screen; in other words, *reality.* But congenial as reality sounds, hardcore on-line addicts will need a little help adjusting to it. They may even want to subscribe to *America Off-Line,* A. J. Jacobs's occasionally hilarious guide to life in the Outernet.

Clearly, Jacobs has logged some painful hours in chat rooms; the best parts of his book concern the do's and don'ts of interfacing in real life. His advice for introducing yourself at off-line parties: "Do not describe yourself...a) you don't have to and b) if you do, you can't lie about what you look like."

In the course of poking fun at the on-line world, Jacobs does the same to its off-line counterpart. He's clearly no technophobe; he's just having a little fun. If you've spent much time on commercial on-line services, you're sure to get a guffaw or two from *America Off-Line.* **–Jenny Donelan**

Internet Dreams: Archetypes, Myths, and Metaphors, by Mark Stefik, MIT Press; $27.50, hard cover

America Off-Line: The Complete Outernet Starter Kit, by A. J. Jacobs, Cader Books, ISBN 0-8362-2433-7, $8.95

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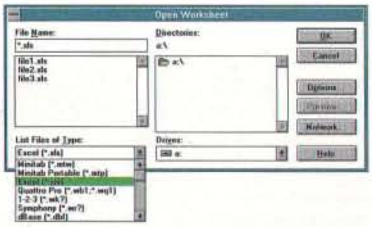

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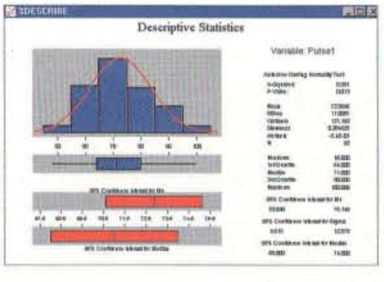

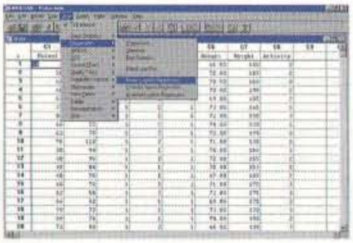

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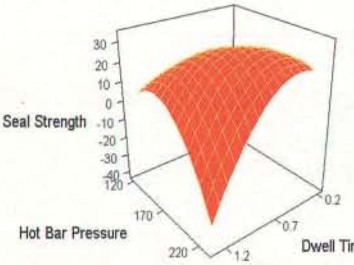

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Goodbye NT for MIPS

The original RISC platform for hosting Windows NT, the MIPS architecture, is getting phased out as a host for Microsoft's enterprise operating system. Microsoft has announced it will cease future NT development efforts for the MIPS platform due to decreasing demand. On NT, the MIPS architecture got caught between Digital's Alpha processor at the high end and the Pentium on the low end; when software developers had only enough resources to support two hardware platforms for NT, the MIPS platform often got squeezed out.

NEC, the manufacturer that sold the most MIPS/NT workstations, says it will no longer build NT machines based on the MIPS platform. However, NEC will continue to make MIPS-architecture chips for Nintendo 64 systems, Silicon Graphics workstations, and the new Windows CE platform.

Although Microsoft says it will continue to support NT 4.0 on MIPS, the company advises customers to evaluate other hardware platforms for future versions of NT. Those hardware choices are PowerPC, Alpha, and x86.

But Cheaper Alpha NT PCs Are Coming

While MIPS gets de-emphasized as a platform for NT, Digital Equipment and VLSI Technology are working to bring less-expensive computers based on the Alpha microprocessor to market. This year, the two companies expect to release the first products that include VLSI-designed core logic chips that will work with Digital's Alpha chips.

Chips developed by VLSI will handle functions such as connecting microprocessors to memory and the PCI data bus, as well as handling peripheral functions pertaining to audio, graphics, input devices, and I/O ports. Digital officials say the goal is to introduce a desktop Alpha PC that will cost about $3000 or less, making that platform more attractive to corporate buyers.

Datapro Report

Security Wake-Up Call

It's time for organizations to stop saying they are concerned with securing their information and get down to the business of doing it. In theory, upper management supports the protection of information assets; in practice, the implementation of security strategies is minimal or nonexistent within many organizations today. That's the conclusion Datapro analysts draw from Datapro's 1996 International Survey of Information Security Issues.

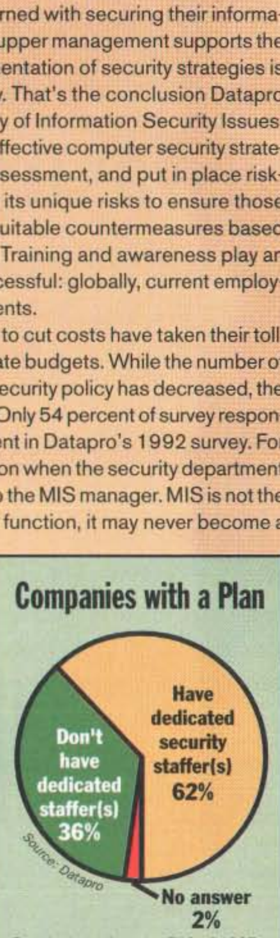
Companies that have implemented successful, cost-effective computer security strategies typically have formed a policy, conducted a risk assessment, and put in place risk-management methods. An organization should identify its unique risks to ensure those areas are covered by the security policy, then execute suitable countermeasures based on priorities and levels established in the policy stage. Training and awareness play an invaluable role in making a security implementation successful: globally, current employees were responsible for 57 percent of all security incidents.

Unfortunately, economic influences such as the drive to cut costs have taken their toll. Funding for security has disappeared from many corporate budgets. While the number of companies with a dedicated security department and a security policy has decreased, the number of companies with no plans for a policy has risen. Only 54 percent of survey respondents in 1996 had a security policy, down from 82 percent in Datapro's 1992 survey. For those companies trying to salvage some form of protection when the security department is dismantled, the responsibility is primarily reallocated to the MIS manager. MIS is not the ideal location—as long as security remains part of the IT function, it may never become a priority. Organizations that have a dedicated person assigned to security are more likely to have a security policy in place.

Companies today place high value on the ability of PCs, networks, mainframes, and databases to contribute to an organization's success. Yet security is still regarded as a drain on the bottom line. Organizations need to stop thinking of security as something that impedes or restricts, like the locks and seat belts in a car. Instead, they should think of security as something that enhances the ride and ensures that you reach your destination, like antilock brakes. The drive for electronic commerce, the phenomenal growth of the Internet, and the increasing popularity of business applications that use public networks require organizations to develop sound information security. Security needs to be regarded as an enhancement that contributes to the bottom line, not a function that drains it.

Rebecca J. Duncan and Jackie Hyde *are information-security analysts at Datapro. For more on Datapro services, call (609) 764-0100 or see http://www.datapro.com.*

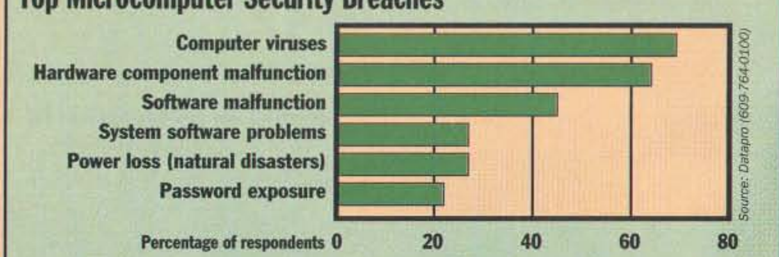
Companies with a Plan



Results based on the 719 of 1337 total respondents who say their company has a security plan.

Firms with a plan often have dedicated security staff.

Top Microcomputer Security Breaches



Figures will add up to more than 100 percent because respondents were able to report more than one type of incident.

Computer viruses are the most common microcomputer security breach.

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News & Views

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1196/cs

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Corel PDA to Bundle Java Suite

Does the world need another PDA? Corel (Ottawa, Ontario) certainly thinks so. The company that has been successful where others fear to tread (taking on Microsoft in the office suite market, for instance) has an interesting offering on tap. The Corel PDA (as yet unnamed) will be powered by a RISC processor and offer a choice of either monochrome or color LCD screen. The hand-held unit will measure about 3 by 4 inches and should retail for less than $500. The company currently plans to release the device in the second half of 1997.

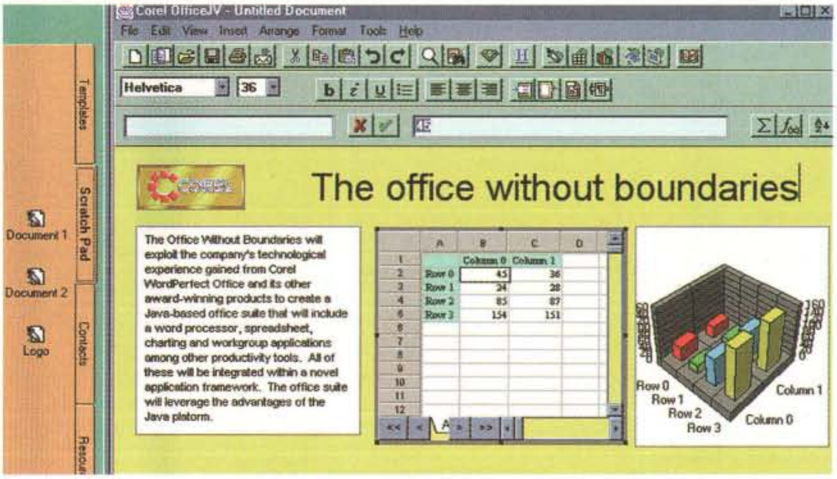
Corel plans to bundle in a suite of applications, including e-mail, a notepad, a contact manager and scheduler, handwriting recognition, and voice annotation. So far, this sounds like pretty standard stuff. But a major part of what sets the Corel PDA apart from other PDAs is the fact that all the applications, including a built-in Web browser, will be programmed in Sun's Java language. Corel's Java suite is slated to ship in the first quarter of this year.

The Java approach provides a number of advantages, Corel says. First, Java applets are relatively efficient, so they make sense for the somewhat restricted PDA environment. It also means that Java applets downloaded from the Internet should run without problem on the Corel PDA. Plus, the platform independence of Java means that any Java application (e.g, Corel Office for Java) should work on just about any Java-compliant platform, including Java-based set-top boxes, network PCs, and other devices. Furthermore, Java should encourage a lot of development from third parties because of this potentially large market. Corel plans to provide a truly open operating system so that developers will be able to create add-on programs for the PDA. The OS itself will be embedded as a kernel into the PDA with the Java Virtual Machine running on top of that kernel.

The device will incorporate integrated communications, so that sending and receiving e-mail or fax messages and getting onto the Internet will not require you to buy additional options or software. The Corel PDA will have a unique keyboard/docking station that will let it synchronize the database with the desktop computer, work as a battery recharger, and give the user a full-size keyboard.

The Corel PDA is being designed to operate in either portrait or landscape mode. The former will be used to work with the PIM-based functions, and the latter for Internet and e-mail access.

As PDAs begin to mature, functional units like the Corel PDA that don't overreach may well rule the market. And with its inherent cross-platform nature, the Corel Java-based office suite may appear on thin platforms where today's resource-intensive desktop PC applications can't fit. **–Jon Pepper**



The office without boundaries

The Office Without Boundaries will exploit the company's technological experience gained from Corel WordPerfect Office and its other award-winning products to create a Java-based office suite that will include a word processor, spreadsheet, charting and workgroup applications among other productivity tools. All of these will be integrated within a novel application framework. The office suite will leverage the advantages of the Java platorm.

	A	B	C	D
1		Column 0	Column 1	
2	Row 0	45	36	
3	Row 1	34	28	
4	Row 2	85	87	
6	Row 3	154	151	
6				
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12				

Corel's new office suite looks like the others, but it's written in Java.

cd-rom review

Learn to Read and Have Some Fun

Finally a great program for three- to six-year-old beginning readers. Richard Scarry's Best Reading Program Ever actually lives up to its hyperbolizing moniker. If children can get by the opening screen that asks them to type in their name, they will be entertained and gently challenged with reading readiness activities. These exercises focus on language, phonics, listening, and following simple directions.

In Miss Honey's classroom, children can click on objects.

There are five main sites in the program. At each site, the child works through a specific learning exercise. Examples of these learning exercises include such things as identifying beginning sounds, matching upper- and lowercase letters in a farm while picking apples, and determining which pictures form the beginning, middle, and end of a story.

As is the case in Richard Scarry children's books, the program's graphics are of high quality. The characters in the various exercises will appeal to children. The program is easy to navigate, and there are handy stop points. In fact, once the program is loaded and launched, the computer fades into the background as if it weren't even there. Beginning readers get a lot of positive reinforcement even when they select the wrong answer, but they are richly rewarded when they complete a task correctly. Simon & Schuster Interactive has done a commendable job making learning to read a fun experience.

–Rich Friedman

Richard Scarry's Best Reading Program Ever, Simon & Schuster Interactive, 1230 Avenue of the Americas, New York, NY 10020; (800) 910-0099; http://www.Mpc.com; $29.95

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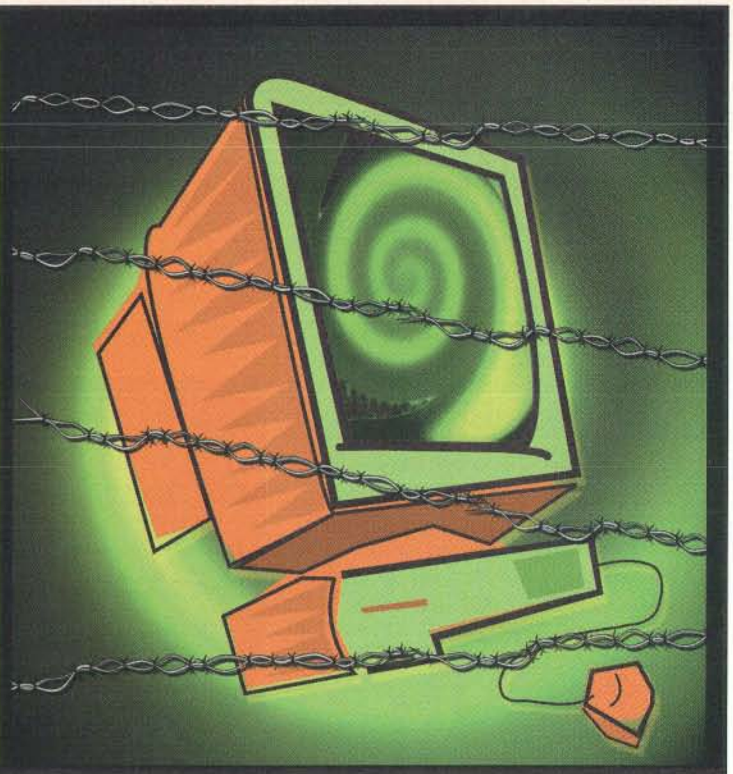

SECURE FILE SYSTEM

Fortres 101 protects boot process, desktop settings and arrangement, and the file system. Secure File System for Windows and Windows 95 on FAT drives allows you to block or control access (full, read-only, no access) to local drives, files, and directories; force user saves to floppy, or specific directories; prevent executing any program from floppies; prevent user from downloading and executing programs. All file security is provided in memory, without modifying the file structure. Provides multi-user or station security for local resources on stand alone and networked PC's. Does not modify the registry. Does not rely on user profile settings. Does not conflict with user profile settings. All security can be turned on and off in seconds without rebooting. Fortres 101 can be unloaded, completely, from memory without restarting Windows. Includes support for both Windows 3.1x and Windows 95 with 16 or 32 bit file access. Does not alter the Windows Interface. There are no visual cues that Fortres 101 is running. Does not patch any DOS or Windows files. Works with Novell, LAN Manager and Microsoft Networks. Central control module is available.

Fortres 101 provides complete desktop and file protection from malicious or inexperienced users.

System Requirements:

- OS: Windows 3.1x, WFW 3.1x, Windows 95
- Dos Memory: 1K (can be loaded high)
- Windows Memory: 35K (3.1x), 55K (Windows 95)
- Disk Space: 400K

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Blasts from the Past

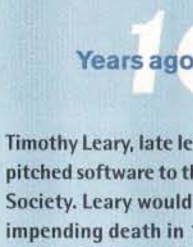
5 Years ago in BYTE

We liked Claris Resolve, a spreadsheet for the Mac. But Resolve, along with other Mac versions of spreadsheets such as 1-2-3 and Wingz, weakened in the face of Microsoft's Office juggernaut for the Mac. We also ran early reports on the Apple/Motorola/IBM alliance and delays in Windows 3.1 and OS/2 2.0.

10 Years ago in BYTE

Timothy Leary, late leader of psychedelia, pitched software to the Boston Computer Society. Leary would later document his impending death in 1996 on the Web, a medium that some feel is a powerful drug in its own right, even more addicting than tobacco. In the same issue, editor Phil Lemmons reminded us that people who said most users don't need the power of a 32-bit processor used to say the same thing about 16 KB of RAM.

15 Years ago in BYTE



We covered the new IBM PC in depth; we figured it was important enough to merit a second look. Guess we made the right call on that one.

20 Years ago in BYTE

We covered hashing techniques that speed up table search operations. North Star advertised 5-inch floppy drive systems for the "unbelievable" price of $599.

Why Java Won't Repeat the Mistakes of Unix

Scott McNealy, chairman and CEO of Sun Microsystems, talks about how Java will change computing and the computer industry.

BYTE: *What's your vision of a Java-centric computing industry?*

McNealy: The whole point of the Net is more than convenience, it's open interfaces. All of a sudden now, no single microprocessor's in charge, no single operating system's in charge, no single vendor's in charge, no single customer is in charge. Regarding Sun's place in this new industry, we believe that we can be one of the three equipment suppliers for data-tone/Web-tone equipment on the client and server side. Wintel, Sun, and IBM are the only three equipment suppliers left. Everyone else is just a dealer of other peoples' equipment.

The problem with Microsoft and Intel is that it's a lot like General and Motors, with Fisher Body separated from Chevrolet, and that's why it takes 10 years to get a 32-bit OS on a 32-bit microprocessor. It's hard to merge them at the end of the assembly line when you're not under the same shareholder agreement.

BYTE: *A lot of the open interfaces—TCP/IP, HTML, for example—are controlled by standards bodies. But you own the Java spec.*

McNealy: No, this is huge: You can go out and write a Java virtual machine to that spec. I will not sue you. So, "own" is too loaded a word. We're going to continue to drive that [spec] forward. If you want to call it Java *the brand*, yeah, we own Java. The problem with Unix is that nobody protected the brand to mean something and the brand lost value.

BYTE: *Is that the primary lesson you take from the Unix experience, that branding was lacking?*

McNealy: I also think that licensing terms of Unix were very, very different. We're fundamentally saying that you don't need a Java license from us to go do what you need to go do. You have to go out and just do a great implementation.

BYTE: *How important is it to Java enterprise computing that you have a compelling Windows compatibility strategy?*

McNealy: We'll provide it the right way. Put it on one server, you only have to buy one copy. And I'm urging every CEO to make sure it [Windows] runs really slowly, so people stop using that stuff. The right way is to ban PowerPoint from your company. The second-best answer is to buy just one copy. And the wrong answer is to give everyone their own personal copy.

When the anthropologists dust off the 1980s and 1990s and look at the productivity dip, they're going to blame Office. I banned PowerPoint from my company and we've had the best two quarters we've ever had in the history of the company. I want to give everybody plastic Mylar sheets and all the pens they need to scribble on them. And I said use what I call the [Sun cofounder] Bill Joy font. You can see where he licked his thumb and erases; it's so much faster.

BYTE: *Suppose the whole world converted to Java-centric computing today. Is the infrastructure there?*

McNealy: That would be a problem. The beauty of the fact that not everybody buys into what we're doing is that it gives us a head start. This is an architecture that really does scale like no other architecture has ever done. It's got all the new stuff built into it, like threading and absolute objects. This is not object-oriented; this is an object-based language. It has enough compelling new features that it is just the right answer.

BYTE EXTRA

INTERNATIONAL

BYTE's Systems 96 Awards

Internet shopping software wins top prize in Munich. Page 40IS 3

Acer, IBM Partnership

Acer lands a Big Blue OEM contract. Page 40IS 4

Digital Watermarks

New technology protects your intellectual property. Page 40IS 7

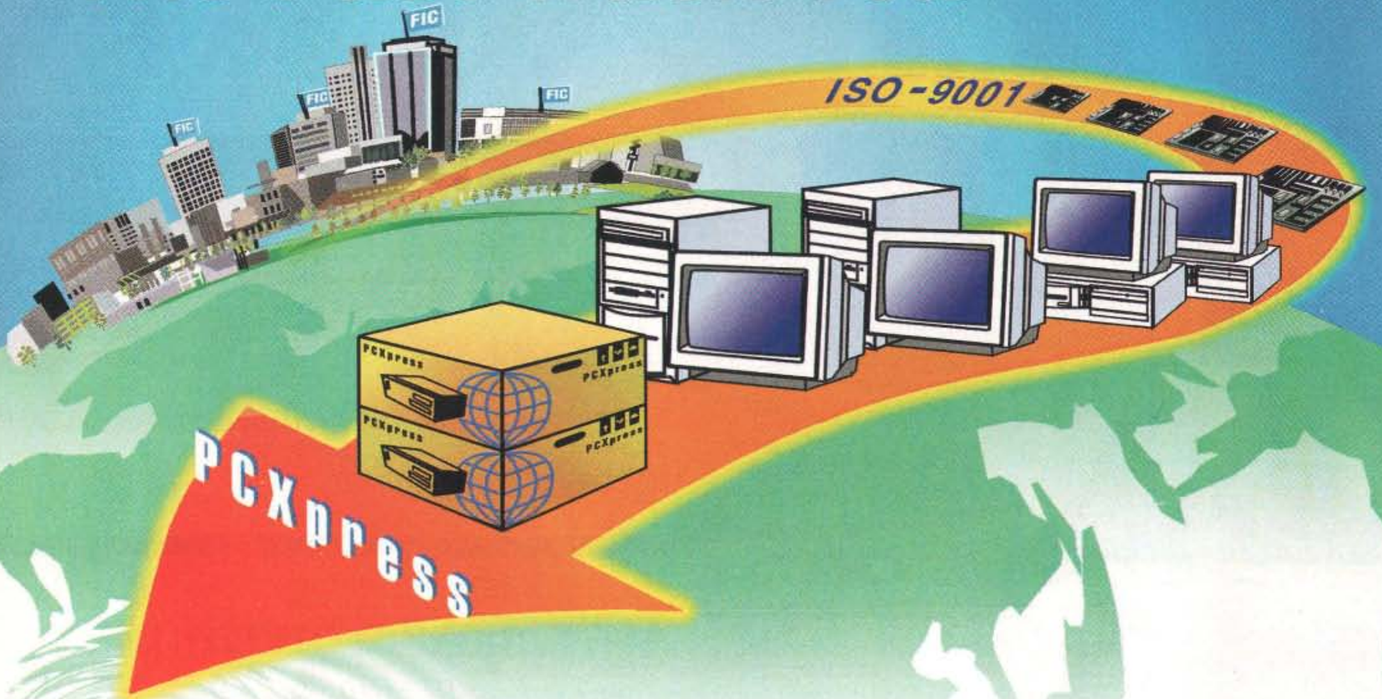
Lights, Camera, Action

Computer-based training embraces the Internet. Page 40IS 13

New Notebooks

From Taiwan: higher clock speeds, digital video drives, and more. Page 40IS 17

The Fast Track To..



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Internet Shopping Software Wins Best of Systems 96

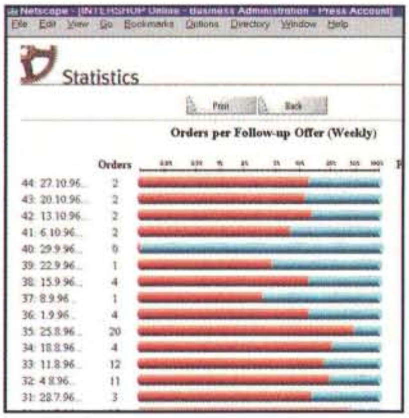
An innovative, out-of-the-box on-line-shopping software package won BYTE's Best of Show award at Systems 96. This award recognizes an important and innovative new product shown at the annual computing-solutions-and-technology show held in Munich.

Voted by BYTE editors as the best of the best new products, NetConsult Communications' (+49 3641 8940; http://intershop.net) Intershop Online is a complete template-based on-line-shopping solution that can handle inventory, billing, shipping, and marketing statistics. Its latest extension, the Intershop Mall, which was announced at the show, enables users to manage a variety of on-line shops side by side on one Web server.

An on-line customer, for example, can select merchandise from a wide variety of shops, just like in a real shopping mall. With the Intershop Mall extension, Internet service providers (ISPs) can easily administer stores for many different merchants. They can control customer-access rights, log in orders, and keep an up-to-date record of payment transactions.

BYTE editors awarded the multimedia prize to the Virtual Assembly technology from the Fraunhofer Institut für Arbeitswirtschaft und Organisation (+49 711 970 2087; Andreas.Roessler@iao.fhg.de). This high-end virtual-reality system simulates the interaction of a human body with objects in cyberspace. It uses a sophisticated virtual model of the human body to simulate the assembly and maintenance of machines that do not yet exist, giving the user tactile feedback during the maintenance tests.

The best communications product the BYTE editors saw on the Munich show floor was Tobit Software's (+49 2561 913 120; http://www.tobit.com) David, a universal inbox for all kinds of business correspondence. This communications-server software for NetWare LANs manages and archives e-mail, faxes, voice messages, and all other types of multimedia documents. The software provides access to these complex documents via LAN, phone, fax on demand, or a Web browser.


Netscape - [INTERSHOP Online - Business Administration - Press Account]
File Edit View Go Bookmarks Options Directory Window Help
Print
Back

Statistics

Orders per Follow-up Offer (Weekly)

	Orders
44: 27.10.96...	2
43: 20.10.96...	2
42: 13.10.96...	2
41: 6.10.96...	2
40: 29.9.96...	0
39: 22.9.96...	1
38: 15.9.96...	4
37: 8.9.96...	1
36: 1.9.96...	4
35: 25.8.96...	20
34: 18.8.96...	4
33: 11.8.96...	12
32: 4.8.96...	11
31: 28.7.96...	3

Intershop Online lets you set up a shopping mall on the Internet.

Network Distributed ISDN for Windows NT, developed by AVM (+49 30

Best of Systems 96 Finalists

Industrial Applications

SAC biometric card validator, from Metra Engineering (+38 6611330387), a security device that recognizes finger characteristics.

Industrial Thermics for Mathematica, by Visual Analysis (+49 89 4319810; info@visualanalysis.com), an industrial computer algebra system for thermal calculations.

Business Management Solutions

Betrex 2.0, from Bissantz, Küppers & Company (+49 9131 6914 50; bissantz@forwise.uni-erlangen.de), a data-mining tool that discovers problem areas in your business.

R/3 Mobile, by IXOS Software (+49 89 460050; http://www.ixos.de), a remote-database-access architecture for SAP R/3 that capitalizes on the GSM Short Message Service (SMS).

Corporate Networking Products

Chameleon NFS/X 6.0, by NetManage (+49 8165 94700; sales@netmanage.de), integrates more than 50 applications under Windows or on the Macintosh.

WiNTimesX, from Lightstone Multiuser Systems (+49 5643 98010; 100524.733@compuserve.com), a low-cost solution for running up to 16 monitors, mice, and keyboards from a single Windows NT PC.

Communications Products

Cell-Ace, from Cellware (+49 30 4670820; http://www.cellware.de), connects private telephone exchanges via an ATM network.

D.I.C.A. 6400 VDM, from DTM Data Telemark (+49 30 20353 309; http://www.datatelemark.com), a modular multiplexer for voice and data compression over ISDN.

Multimedia Products

The DC30, from miro (+49 531 21130; http://www.miro.de), an inexpensive video-editing card that brings studio quality to the home computer user.

Virtual Vision 1.0, from VR-Systems (+49 89 32470321; http://www.vst.de), a 3-D software application package that combines high-end, low-cost virtual reality with an innovative user interface.

Internet Products

Isys Web, from Isys/Development, Inc. (European contact: ISG, +49 8122 910180; http://www.isgweb.com), a search-and-retrieval software package for Web servers.

Safe Guard IPN, by Utimaco Safeware (+49 6171 9170; http://www.utimaco de), facilitates the task of setting up virtual private networks on the Internet.

39976 0; http://avm.de), clinched the title in the Corporate Networking Products category. This communications software package allows an unlimited number of network users to share one or more ISDN controllers. With this program, each LAN workstation gets its own virtual ISDN interface without being physically connected to the ISDN network.

The honors for Best Business Management Solution went to ISD/Professor Scheer's (+49 681 9921 0; ids@ids-scheer.de) Aris Applications, which is the latest component of the Aris business-process-engineering tool set, for its high level of application, process, and work-flow integration. Aris Applications generates stand-alone applications directly from operative work-flow models.

The winner in the Industrial Applications category was TS Technische Software's (+49 711 77970; http://www.ts-software.de) Guard IV, a quality-management system that supports production-process control. The software package has the ability to handle a variety of events and exceptions that standard production-planning systems cannot cover and thus makes factory work flow more secure.

–Rainer Mauth

Acer, IBM Forge Deeper Partnership

In a deal that reflects the ongoing breakdown of the traditional PC-manufacturing model, IBM recently signed a $1.8 billion agreement with rival company Acer, under which the Taiwan firm will build and distribute as many as 80,000 desktop PCs per month for resale under the IBM logo, sources say.

The IBM/Acer alliance follows similar moves by other PC companies—including Compaq, Packard Bell/NEC, and others—that analysts say are now outsourcing everything from manufacturing to distribution as a way to expand their capacity, reduce costs, and find ways to tap into new markets.

In the past, many PC companies attempted to assemble and distribute everything themselves, but it's difficult to make a buck under this model. "It appears that Acer may have a global agreement to manufacture and distribute a variety of products for IBM," says Donald Floyd, research analyst with Asia Securities in Taipei. "If IBM and other major PC companies follow this path, they may be able to reduce their manufacturing costs by about 15 percent instead of doing it all by themselves."

The first company to explore this global-outsourcing model was Compaq, which in 1995 signed a manufacturing alliance with Taiwan's Mitac. At present, Compaq's low-end PCs are made and distributed in various markets by Mitac—a move that has kept the U.S. company in a leadership role in the PC business.

Packard Bell/NEC also has a global manufacturing and distribution alliance. In fact, the partnership procures a large number of PC boards from Intel, but it also has a significant OEM alliance with Taiwan's GVC. In addition, NEC and GVC have a joint venture in China to produce color monitors.

IBM is also no stranger to outsourcing in Taiwan, but it's mum about its new alliance with Acer. For more than two decades, IBM has procured components and peripherals in Taiwan. But it has obtained only a small portion of finished PCs from Taiwan, mainly notebooks made on an OEM basis by a company called ASE.

Acer is also reluctant to talk about its partnership with IBM, which goes far beyond the typical OEM contract. For example, Acer will not only manufacture—and perhaps design—PCs for IBM, it will also be put in charge of global logistics and distribution for the U.S. company. "For IBM, Acer can be viewed as a competitor or partner—or both," comments Jason Lin, industry analyst with Dataquest Taiwan in Taipei. "However, IBM and other U.S. companies know they are under severe pressure to bring down their manufacturing costs."

Until recently, Acer had been making finished PCs for Fujitsu/ICL, Hitachi, and others. But the Japanese companies have discontinued buying finished PCs and instead will buy only boards from Acer in the future. Acer's OEM business is larger than its own name-brand PC segment. Its total OEM business hit $1.176 billion in 1995, compared to $642 million in 1994.

Acer walks on a delicate path of pushing its own brand name while selling PCs and component-level products to competitive OEMs. Acer has major plans to boost its OEM and non-OEM businesses. To do so, in 1996 it expanded its total production capabilities, nearly doubling its output of PC-related products. In 1996, Acer had the capacity to churn out 700,000 PCs, 100,000 notebook PCs, and 350,000 CD-ROM drives per month.

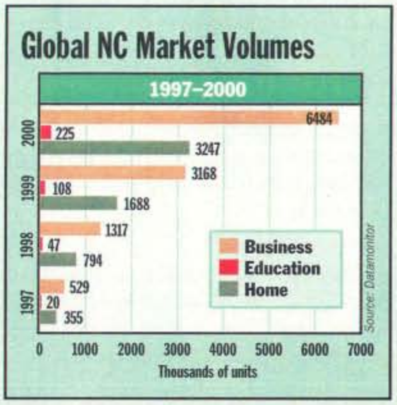
–Mark LaPedus

Who Will Buy a Network Computer?

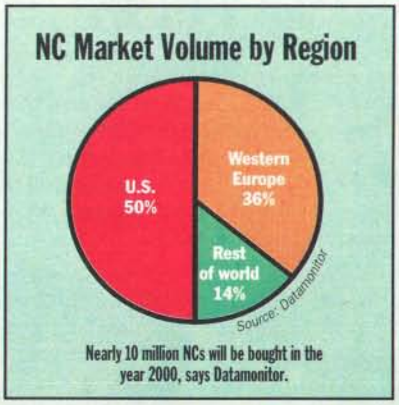
Almost 10 million network computers (NCs) will be sold worldwide during the year 2000, the management consultancy Datamonitor (London) forecasts. This figure includes only dedicated NCs, not devices with limited Internet access, such as game consoles.

Of these 10 million units, a little under two-thirds will be sold to the corporate and government markets, and a little under one-third to the consumer market. However, the consumer market is expected to grow rapidly. Educational establishments will make up the remaining small portion. But the NC market will still be dwarfed by PC statistics: Datamonitor says that the NC market volume in 2000 will constitute only 2.5 percent of the global PC market.

–R.M.


Global NC Market Volumes

Source: Datamonitor


NC Market Volume by Region

Source: Datamonitor

Nearly 10 million NCs will be bought in the year 2000, says Datamonitor.

Corporations and governments are projected to buy 6,500,000 network computers in the year 2000.

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Look, It's Not There

Digital watermarking is the best way to protect intellectual property from illicit copying.

By Jian Zhao

Why is it so difficult to find a needle in a haystack? Because of the size of the needle relative to the size of the haystack. Also, because once the needle falls out of your hand, it is not predictable where it will land in the haystack. Both principles—inconspicuousness and randomness—help conceal information in *digital watermarks* to protect intellectual property of multimedia documents.

ILLUSTRATION: DOUG FRASER © 1997

In contrast to a traditional watermark on an invoice, for example, a digital watermark can be detected only by appropriate software. Rather than ensuring the authenticity or integrity of documents, as a digital signature or a digital seal does, a digital watermark aims to identify the origin, author, owner, usage rights, distributor, or authorized user of an image, video clip, or audio clip, even if the image or clip has been processed and distorted (via analog-to-digital conversion, low-pass filtering, resampling, lossy compression, cropping, or rotation).

A digital watermark has to be invisible—or, in the case of music and sound files, inaudible—but nevertheless persistent. Otherwise it could interfere with the quality of the document and also be more easily removed after illicit copying. (For more information on digital copyright protection, see "Handcuff Digital Thieves," BYTE international edition, April 1996.) A watermark must be able to withstand any processing and tampering. It must be present throughout the whole document in case parts get cut off or cropped.

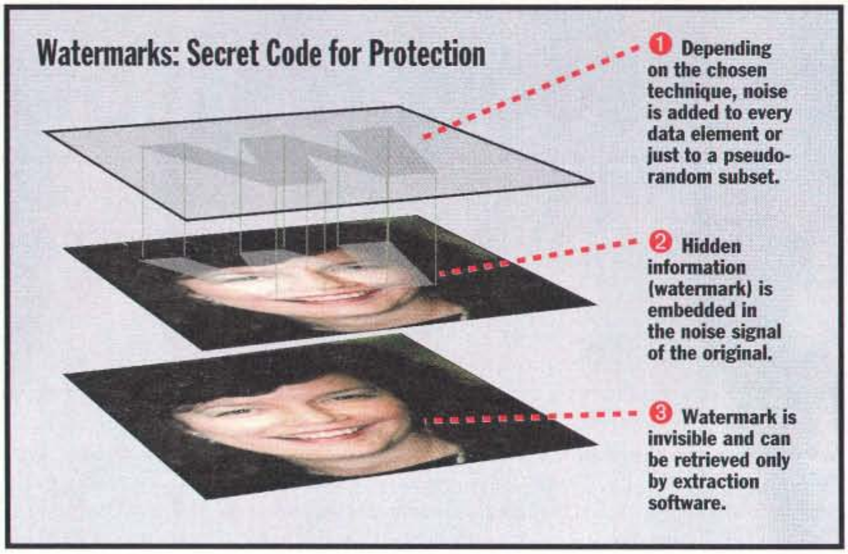
Although digital watermarking is relatively new as a means of protecting intellectual property, the theories and technologies behind it have been around for a while: computer-based steganography (cryptography), spread-spectrum communications, and noise theory.

Traditional steganographic methods vary from simple invisible ink, microdots, and character arrangements to covert channels in digital communications. Earlier computer-based steganographic tools are inadequate to meet the stricter requirements of digital watermarking. Modern steganographic systems use spread-spectrum communications to transmit a narrowband signal over a much larger bandwidth so that the spectral density of the signal in the channel looks like noise.

The two different spread-spectrum techniques these tools employ are called *direct-sequence* and *frequency hopping*. The former hides information by phase-modulating the data signal (carrier) with a pseudorandom number sequence that both the sender and the receiver know. The latter divides the available bandwidth into multiple channels and hops between these channels (also triggered by a pseudorandom number sequence). Combinations of these methods have been widely used in the military to covertly transmit messages. In copyright watermarking, the digital image, video clip, or audio clip represents the wideband communication channel, and the watermark corresponds to the narrowband signal.

Noise is not just an awkward companion of analog communications, it is also an ingredient in any digital information and a fundamental premise of digital watermarking. The process of watermarking encodes the hidden information as additional noise and incorporates it in the document. Modifications of the original's noise signal caused by moderate levels of *wideband* noise or controlled reduction of noise are not visible or audible.

Most common watermarking methods for graphics and audio signals work in the spatial, time, or frequency domains. The advantage of frequency-domain watermarking is that the watermark is spread throughout the whole video or audio clip and hence is resistant to cropping or cutting. However, a standard frequency


Watermarks: Secret Code for Protection
❶ Depending on the chosen technique, noise is added to every data element or just to a pseudorandom subset.
❷ Hidden information (watermark) is embedded in the noise signal of the original.
❸ Watermark is invisible and can be retrieved only by extraction software.

Digital watermarks hide the identity of an image or audio file in its noise signal.

filter, or a lossy compression algorithm, which usually filters out the less significant frequencies, could damage the watermark.

Watermarks can also be embedded in an image's luminance and color bands, or in the contour and texture of an image. Common watermarking methods use the luminance band since it contains the most significant information of a color image.

Watermarking Tools

There are two different categories of watermarking tools available. The first is based on *fingerprinted binary information* (FBI), as exemplified by an eponymous product from the U.K. company High-Water FBI. The other, based on watermarking techniques developed at NEC Research and the University Catholique de Louvain (Belgium), identifies documents by hidden numbers (*fingerprints*). Other approaches, such as SysCoP (System for Copyright Protection), developed at the Fraunhofer Institute for Computer Graphics; Digimarc, from Digimarc (Portland, OR); and Argent, from DICE, can encode additional identification information such as the author's name or the ISBN number of a book.

Direct-sequence and frequency-hopping spread-spectrum techniques are the major watermark embedding methods used in existing tools. Both modify the noise value of the target documents. The direct-sequence technique adds noise to every element of the document, whereas the frequency-hopping method selects a pseudorandom subset of the data to be watermarked. Digimarc and FBI, for example, use direct-sequence methods to superimpose a watermark over an image by modulating a noise pattern of the same size onto the image. SysCoP, however, uses a secret key to pseudorandomly select blocks and frequencies that are modulated within the block.

Other systems use secret keys to determine which lines or words of a text will be slightly shifted vertically or horizontally. Hiding secret messages in the least-significant bits of some pseudorandom frequencies or pixels of an image, which is a common approach employed in many steganographic tools, can also be considered a simple example of frequency hopping. Because frequency hopping modifies only a subset of pixels or other elements of a document, it tends to be much faster than direct-sequence methods. It is, however, less robust and more vulnerable to attack.

Watermark Extraction

A watermark must be extractable even from degraded documents that might have been photocopied, scanned, or manipulated by imaging programs. If a degraded document does not have the same format, resolution, or physical size as the original, it has to be normalized to the original format before the watermark can be extracted. Typical normalization processes include format conversion, resampling, enlarging a cropped part to full size, and scaling of the signal level.

Watermark extraction includes two main steps: selecting the locations where the watermark has been inserted (only in frequency hopping) and retrieving the watermark from those locations. The retrieval process normally needs either the original, unwatermarked data or the

Steganography Overcomes Cryptography Restrictions

Not only can computer-based steganography be used to embed a watermark in a file to protect intellectual property, new steganographic tools can be used to hide messages in digital images and sounds. This has profound implications for government-certified encryption schemes (e.g., the U.S. Clipper chip initiative and other key-escrow techniques) because with messages hidden in a digital image, anyone can inconspicuously exchange secrets and thus overcome restrictions on cryptography (see "Europe: Who Holds the Keys?," BYTE international edition, April 1996).

There are numerous programs for hiding data in pictures (see http://www.sevenlocks.com/SteganographySoftware.htm). One of the better-known programs is EzStego by Romana Machado (http://www.fqa.com/ezstego/). It manipulates an image's color palette and puts the binary data of the hidden message into the least-significant bit of the pixels in the image.

Computer-based steganography not only works with pictures or texts but also with digitized speech. A group of information security experts at the Universities of Dresden and Hildesheim in Germany demonstrated last year that it is possible to transmit undetectable data along with speech during an ISDN phone call. Although the demonstration, at the Information Hiding Workshop in Cambridge, U.K., didn't work in real time, the German experts claim that a real-time application can easily be derived.

As Andreas Pfitzmann, professor at the University of Dresden, puts it: "Computer-based steganography proves that restrictions placed on cryptography on any digital medium are nonsense." **– Rainer Mauth**

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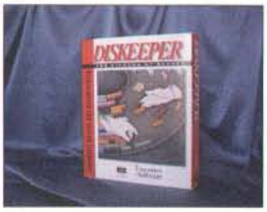

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added noise for comparison with the watermarked document. It is also possible to extract the watermark without the original data. In this case the algorithm detects specific properties and patterns from the watermarked document. These patterns can be represented as signal shapes or the *cross-correlation* between certain document elements. This retrieval method is generally more efficient and enables, for example, SysCoP to retrieve watermarks in real time.

By applying multiplexing techniques as in data communications, the SysCoP system, for example, can embed several identification codes and extract them separately. This feature is extremely important for identifying ownership and other intellectual property rights in works composed of many copyrighted assets, such as a complex multimedia presentation.

This kind of hierarchical watermarking can also be a danger to copyright protection if subsequent watermarking tries to overwrite the previous identification. However, uncontrolled hierarchical watermarking can cause accumulation of noise and hence create perceptual defects such as patterns or blocky images or, in the case of audio streams, hiss. Some watermarking systems—HighWater FBI, for instance—prevent this overwriting attack by permitting only one-time watermarking. In addition, watermark registration or deposit of watermarked documents in trusted agencies may provide more effective means to prevent watermark overwriting.

Counterfeiters Beware

With the pervasive expansion of multimedia, electronic publishing, and electronic commerce, publishers, artists, and service providers are seeking solutions to protect copyrights and revenue streams. For them, digital watermarking is a major step forward. The role this technology can play in copyright protection is twofold. On the one hand, it provides evidence of illicit copying and dissemination; on the other hand, it constitutes a

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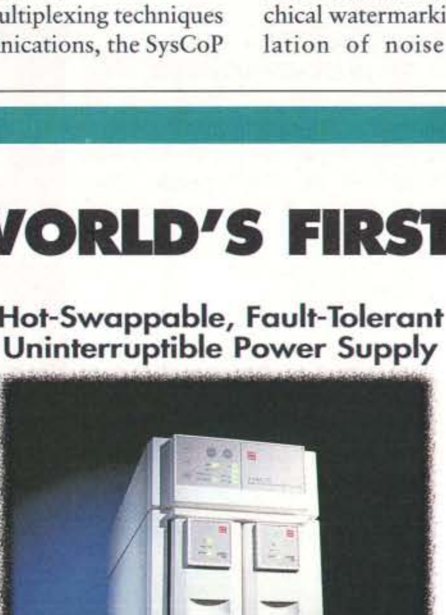
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How to Embed a Watermark

Embedding a watermark requires three functional components: carrier selector, watermark generator, and carrier modifier. A watermark carrier is a list of data elements selected from the original unwatermarked signal and used for encoding a watermark (i.e., a sequence of noise-like signals). The noise signals must be generated pseudorandomly, depending on secret keys, but independent of the carrier. Ideally, the signal should be at maximum amplitude but below the levels of perceptibility.

The carrier modifier adds the generated noise signals to the selected carrier. To balance the tolerance level of the additional noise and the robustness of the watermark, the noise must be scaled and modulated according to the strength of the carrier.

To find the right embedding parameters, psychovisual or psychoaudio analysis and predistortion are effective means of generating the appropriate amounts of noise and modulation. The idea of predistortion is to optimally adjust noise and scaling parameters by continuously controlling the watermark's resistance to image processing during the embedding procedure. This requires an iterative embedding and distortion sequence that continuously evaluates and adjusts the noise level.

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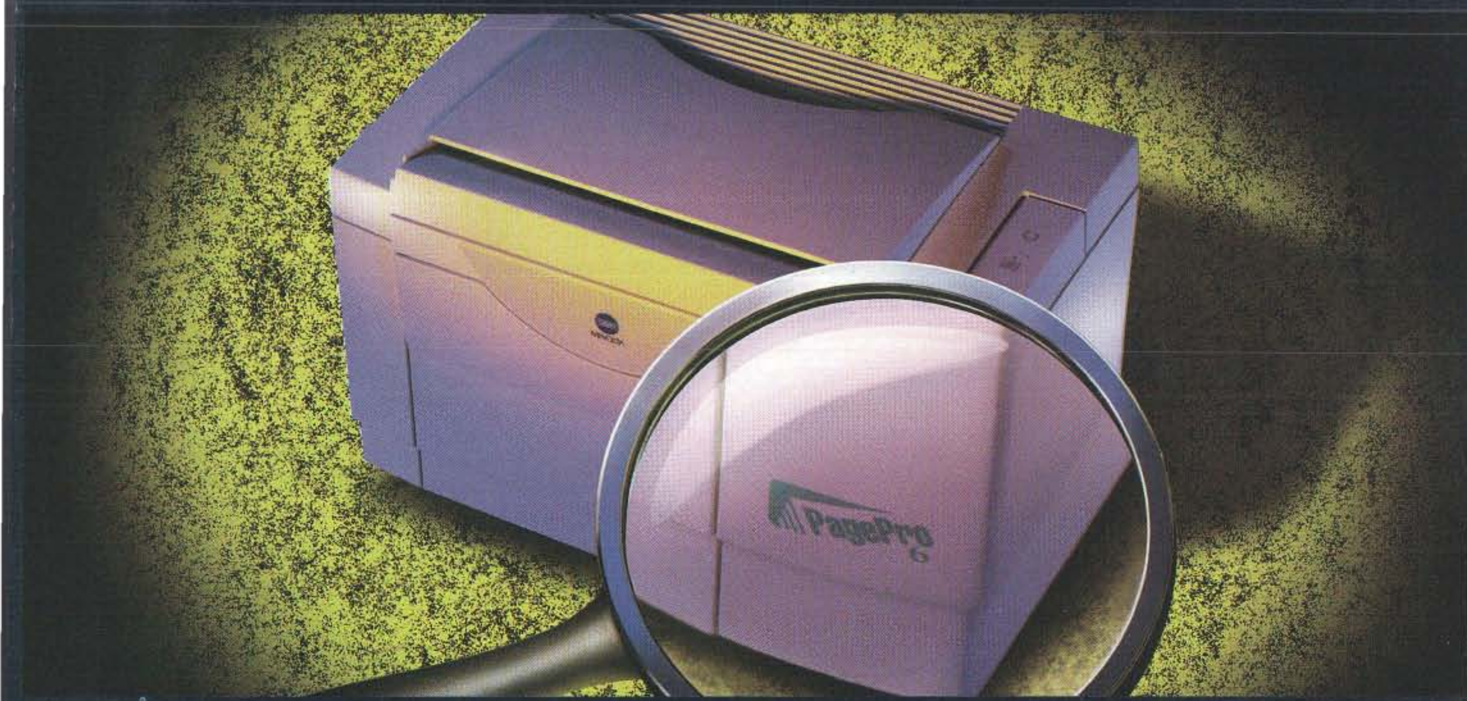

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deterrent so that consumers as well as counterfeiters are likely to be more careful about duplicating and redistributing copyrighted material because they know illegal copies can be traced back to them.

Though commercial use of digital watermarking has begun—Adobe is using Digimarc's technology in the new Photoshop 4, and IBM will use its own technology in its InfoMarket electronic commerce products—there are still several barriers preventing this technology from becoming effective and widespread. The technology for digital copyright watermarking is still in its early development. The major technical challenge is to develop a foolproof protection system while keeping watermarks hidden. Absolute robustness is impossible, but there is room for improvement as this technology gains more acceptance and wider use. Today, none of these systems can claim that its watermarks will survive all imaging or signal-processing operations. But like encryption, this technology will be useful as long as it makes tampering with or removing watermarks a time-consuming and costly task.

Enforcing Watermarks

Digital watermarking helps protect intellectual property. But protection is effective only if a legal force with a good tracing system sits behind it. A European R&D project called TALISMAN–for Tracing Authors' rights by Labeling Image Services and Monitoring Access Network–is one of the first efforts to establish an independent agency for monitoring watermarks and tracking down copyright infringements. (See http://www.tele.ucl.ac.be/TALISMAN). TALISMAN will provide interfaces to copyright enforcement and management tools.

International activities, such as the European Copyright Management System (ECMS), have paved the road for watermarks to obtain legal status. Although far from being an accepted global standard, watermarks may be used as evidence in court just like fingerprints or blood samples.

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Lights, Camera, Action

CBT developers are using advanced movie-making techniques and the Internet to deliver rapidly changing content.

By Valerie Thompson

The more people are entertained, the more they'll retain. Computer-based-training (CBT) developers are finally churning out products worthy of that old maxim: Video, audio, and hypermedia are essential ingredients for better training. The latest wave of CBT software, which is just starting to appear in Europe and the U.S., features advanced simulation techniques, hypervideo, and the use of intranets to increase the level of user involvement and interaction.

The benefits of CBT are well known: more-consistent training materials, better evaluation for students and administrators alike, and more flexibility with regard to when and where learning takes place. CBT can also dramatically shorten the delivery time of course content. For example, Deutsche Bank was able to reduce a five-day sales-training course to just two days by using seminar-style training to introduce new financial products and video-based simulations to demonstrate appropriate sales techniques.

Today, CBT delivers training materials to users in almost every large public- and private-sector organization. Big organizations are often so lean and downsized that they can't afford to have staff members away from their jobs for long periods of time, making CBT a must. Furthermore, these organizations are often decentralized. For them, the consistency and reduced learning time that CBT offers are major benefits; in addition, the cost of training is lower than with other methods.

ILLUSTRATION: DOUG FRASER © 1997

Soaring Sales

CBT is growing rapidly. According to Inteco's (Woking, U.K.) report titled "Software Markets in Europe," training-software sales are growing at a rate of 25 percent per year. The market volume for 1996 was about $588 million; the company estimates a rise to $1.52 billion annually by the year 2000. It's no coincidence, then, that many of the multimedia developers in Europe with the highest revenues concentrate on CBT. In Germany, for example, eight of the top 10 multimedia applications developers are working on CBT applications, according to Joachim Graf, editor of the German Multimedia Magazin (Hightext Verlag).

Duncan Garfield of Training Direct (Harlow, U.K.), a training-resource provider, says that the same is true in the U.K. "Of those companies in the U.K. that produce genuine multimedia applications outside the consumer market, CBT developers are the most successful," he says.

Today, CBT applications generally run on stand-alone PCs that support audio, video, and a CD-ROM and that are usually not networked. However, the emergence of the Web and the proliferation of company intranets may eventually make the platform choice superfluous.

The major advantages of intranet CBT are platform independence and the networked interaction between learner and instructor. Other benefits are that on-line tests in Hypertext Markup Language (HTML) format can be easily processed, and shared workspaces with whiteboards and audio permit communication between learners. Thus, the most persuasive argument for using the Internet and intranets in CBT applications may be a pedagogical one. "The Web and other networks let us take well-designed multimedia applications and strengthen them," says Patrick Littlefield of MicroMentor (Boston, MA).

One of the top multimedia developers in Germany, MIT (Friedrichsdorf), is creating a so-called virtual learning center (VLC) using intranet technology. This is an attempt to re-create on the network a content-rich physical learning center comprising a virtual information source, a library, a classroom, and an on-line meeting place for employees.

The important elements of pilot VLC projects are the servers, with their training archives, statistical features, and message-distribution and message-retrieval modules. A VLC server also offers e-mail, voice mail, chat rooms, forums, BBSes, whiteboards for shared workspaces, audioconferencing and videoconferencing, and screen and applications sharing. A VLC knowledge base enables users to choose from a multitude of self-directed learning methods and explore individual training strategies.

MIT has been working with the Fraunhofer Institute for Computer Graphics (Darmstadt, Germany) and the University of Graz, in Austria, to design such a client-/server-based VLC. The first VLC project, which was completed in September, used custom C++ programming. The developers are now working on a new version, based on Java and ActiveX.

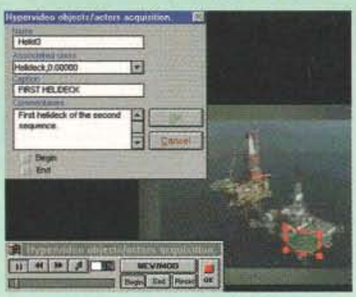
Hybrid Applications

Until independent intranet-based CBT applications become widely available, hy-

Create Hypervideo

If you know what hypertext is, it's easy to understand how hypervideo works. Without interrupting a video, a hypervideo's hot spots can link you to other sources of pertinent information. To obtain more information regarding any object, actor, or background in a video, you just click on it; you're then linked to text, photos, sound, video, or other content-delivering applications.

Arts Video Infographique's (Poissy, France) MOVideo hypervideo application generator lets you link up to four different hot spots to each object without doing any programming. It offers a choice of 15 fade-in and fade-out effects; is directly usable on CD-ROM; and supports a large number of image, sound, and video formats.


Hypervideo objects/actors acquisition.

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MOVideo lets you make video as interactive as hypertext.

MOVideo SDK is the package's tool for integrating video into a multimedia application. It provides DLLs for PCs and XObjects for the Mac and supports such compression codecs as Indeo, Cinepak, MPEG, and M-JPEG. In addition, hypervideo generated with MOVideo can integrate with many authoring environments, including those from Apple, Asymetrix, and Macromedia.

Jean Claude Stella of Arts Video Infographique comments that MOVideo is suited for presentation, education, and training applications alike. He also believes that hypervideo will have a major impact on interactive TV and interactive games, two areas that will grow rapidly.

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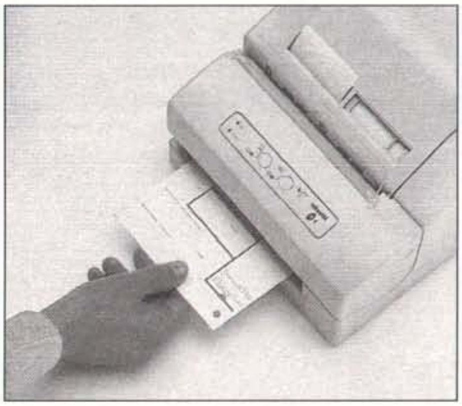

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brid applications, such as CD-ROMs with Internet updates, will be the standard. Hybrid applications overcome Internet bandwidth shortage while enabling up-to-date video- and audio-enriched programs. They store vast amounts of multimedia data locally on a CD-ROM and only update the source materials that are stored on the network.

This approach works well for courses with rapidly changing content. The first hybrid CD-ROMs equipped with browser software and content in HTML format are just now emerging in Europe.

The architecture of today's CBT applications is basically a series of frames that take the student through the course material. Management of the information is based on a hypertext or flowchart model with conditional logic and branching. Unlike a classical hypertext architecture, where paths through a body of knowledge are ad hoc and determined by the user, the branch model of a CBT flowchart requires predefined paths. A storyboard defines the content of the training course, user interface, and interactions, and it links the content to the flowchart (see "What's the Story?," March 1996 BYTE).

In the past, multimedia applications developers often had to create their own authoring tools and systems. According to Edgar Brütsch of HQ Lern und Informationssysteme AG (Sissach), one of Switzerland's top CBT companies, many developers continue to employ their own authoring systems, although they're getting too expensive to maintain and too complex to keep up to date. But he notes that while off-the-shelf tools have improved dramatically over the past few years, they are often too slow.

The off-the-shelf tools that European developers like the most are Asymetrix's ToolBook, Macromedia's Director and Authorware, and IconAuthor from AimTech. Most of these authoring tools do not require programming skills, but they offer visual approaches to developing CBT components that can be reused and recycled as training methods need refinement or as content has to be updated.

Easier Content Updates

One important rule most experienced CBT developers cannot overemphasize is to separate the programming structure from the multimedia content. They say that graphics, animation clips, and video and audio segments best reside in their native formats. The practical benefit is that if a particular piece of content appears several times on the storyboard, it's sufficient to store it only once and refer to this original in different contexts. This also makes updates and changes more efficient and saves storage space and maintenance costs.

Furthermore, by separating the programming structure from the content, graphic designers and video producers can work in parallel with programmers to develop subsequent pieces of an application concurrently. Developers can redirect instructional paths and programming structures when course content changes, if globalization is required, or if relevant laws and regulations change over time and need to be updated. In addition, a training course's original writers, who are often experts on the subject matter in question, can more easily maintain and refine the content.

Separating the programming from the content is closely related to the modularization of programs. Clearly, it's object-oriented programming that enables flexibility and moves CBT away from the

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complex, tailor-made software programs of the past. Developers in France, Germany, the U.K., and other countries say that they regularly reuse elements of their software libraries and combine them with either Visual Basic or an authoring tool. This helps to keep the program development time to a minimum.

Hypervideo Follows Hypertext

"Dramatized video is a superb way of engaging and sustaining the learner's involvement in a complex training assignment," says Mark Iliff of Price Waterhouse (London), a company that has been using and developing CBT for 10 years. But video also serves as an excellent user interface for navigation inside multimedia applications.

For example, Arts Video Infographique (Poissy, France) has developed MOVideo, a program that lets users navigate inside a video. This *hypervideo* software can turn any actor, object, or background in a video into a hot spot and link it to any other information source (see the text box "Create Hypervideo" on page 40IS 14). This feature is particularly useful for CBT applications because it allows a more direct interaction with the actors and objects in a video.

The constant improvements occurring in the processing, 3-D graphics, and video power of PCs will soon enable a new generation of CBT applications that includes smooth graphics animation, full-screen video, and realistic scenarios that you can solve using what-if simulations. These kinds of simulations are possible today only with the performance and graphics power offered by advanced, powerful multimedia PCs.

WHERE TO FIND

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In one real-world example of the power of CBT, transportation authorities are starting to use sophisticated 3-D computer simulations to help their employees understand and predict emergency situations. Research has revealed that if staff members can run through simulated stress situations to understand their own reactions to them, they will have a much better grasp of how to conduct a search-and-rescue operation or give directions in a real emergency. ■

Valerie Thompson is a freelance writer based in Zürich, Switzerland, who tracks telecommunications and multimedia developments. You can reach her by sending e-mail to **100271.257@compuserve.com.**

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New Notebooks

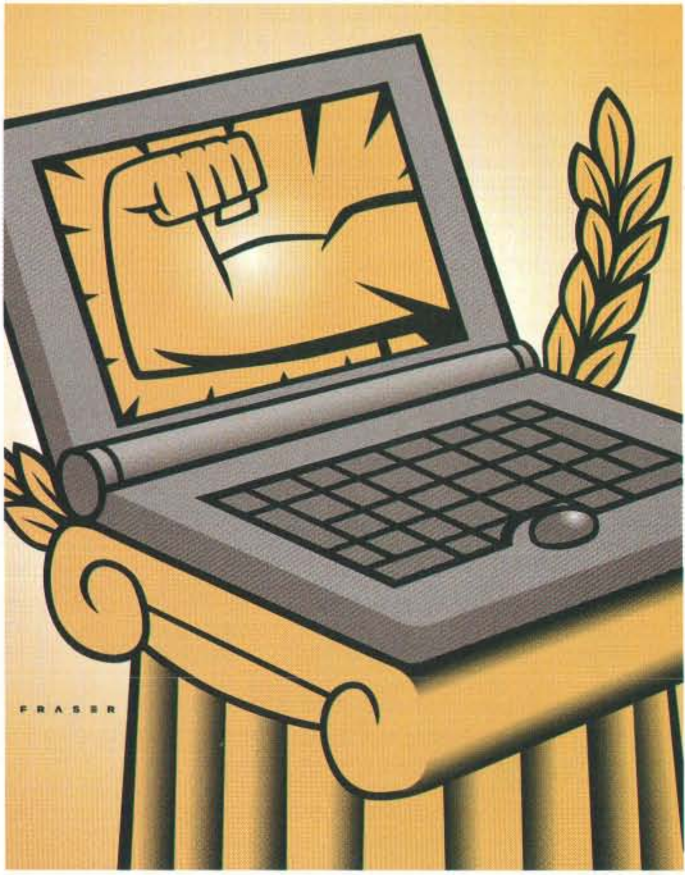
This year's notebooks sport upgraded communications, advanced multimedia, bigger screens, and better battery management technology.

By Mark LaPedus

Mobile computing is undergoing some radical changes in terms of new technologies, architectures, and overall functionality. These technologies are turning the once-limited notebook into a true desktop—or even workstation—replacement.

This year's upscale notebooks include many desktop features, such as Pentium-level CPU modules with multimedia extensions (MMX), 13-inch or larger LCDs, 128-bit VGA graphics, digital-videodisc (DVD) drives, fast modems, and chip sets that support synchronous DRAM (SDRAM), the universal serial bus (USB), and FireWire. New form factors, wireless technologies, videoconferencing, and advanced OSes such as Windows NT are turning notebooks into portable offices for mission-critical applications, says Wu Teng-Guo, regional marketing manager for Toshiba's Asia-Pacific notebook operations in Singapore.

Today's notebooks can do much more than last year's notebook models. For example, a notebook can connect to a Global System for Mobile Communications (GSM) cellular phone via a PC Card. This lets you send or receive e-mail and faxes, and access the Internet over a wireless network, points out Evis Lin, director of Acer's Mobile Systems Business division.



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Key Technologies

Has the notebook displaced the desktop PC? Not yet. Today's desktop systems have an advantage in price and performance, and they do not run on batteries. Still, some key technologies will continue to narrow the gap between notebooks and desktop systems: fast microprocessor units (MPUs), MMX, wireless network adapters, videoconferencing, communications, and improved battery life.

One place to look for notebook trends is Asia. Japan's Toshiba is the world's largest notebook supplier. NEC is also a major player. In addition, Fujitsu, Hitachi, and Sharp have recently entered the notebook market. Japanese companies are formidable competitors because as well as selling systems, they also make their own key components, including DRAM, ICs, LCDs, and, in some cases, batteries and peripherals, such as the upcoming DVD drives.

However, many Japanese suppliers—and U.S. and European vendors—have their notebooks made in Taiwan. Taiwan is now the world's largest maker of portables, according to the government-sponsored Market Intelligence Center in Taipei.

Like desktop systems, notebook product cycles are shortening, while technologies such as MPUs and screens continue to evolve quickly. In the last 18 months, for example, notebook makers have seen their CPUs change from 75- to 100-MHz 486DX4s to 150- to 200-MHz Pentiums with MMX. LCD sizes have zoomed from 10.4 inches to 13 inches or larger. Prices for notebooks became even more attractive when LCD costs fell. Over the last year, South Korea's Samsung and LG Electronics moved into thin-film-transistor (TFT) LCD production, causing Japanese suppliers to cut their screen prices.

In mid-1996, a notebook with a 133-MHz Pentium, an 11.8-inch LCD, a four-speed CD-ROM drive, and a 720-MB hard drive sold for $2800, according to Dataquest. By the middle of this year, a notebook with a 166-MHz Pentium, an 11.8-inch LCD, a six-speed CD-ROM drive, and a 1.2-GB hard drive will go for about the same price.

Lots of Heat

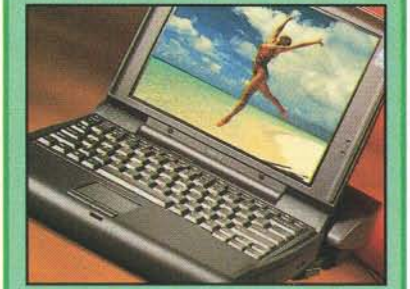
Notebook designers have for the time being abandoned the idea of placing Intel's Pentium Pro processor in a portable. A standard Pentium Pro generates more than 20 W of power, making heat dissipation and battery life a nightmare. A Pentium Pro would have to dissipate some 8 W before it becomes feasible to put it in a portable, says Michael Lim, marketing manager at Featron, a Taiwan notebook maker. Even Intel is discouraging vendors from putting a Pentium Pro in a portable until early this year, when it will offer an MPU-on-a-card for notebooks, says Jerry Kao, technical marketing manager for mobile systems at Intel Taiwan.

MMX Notebooks

Before that happens, though, notebook and desktop PC makers will first embrace Intel's Pentium-level processors with MMX, a new series of instruction sets in the x86 architecture that boosts multimedia performance (see the text box "Enhanced Multimedia Performance" below). Then, Intel will ship the MPU-on-a-card for notebooks. This is much like Intel's approach to its next-generation Pentium Pro, code-named Klamath.

Intel's MPU-on-a-card notebook module is a 4- by 2.5-inch card that sits on the system's motherboard. It consists of a Pentium, the "north-bridge" portion of Intel's Mobile Triton II chip set (called the 430TX), a voltage regulator, and some L2 cache memory.

AcerNote Nuovo



Current System

The AcerNote Nuovo is a sleek midrange notebook featuring a heuristic power management system that offers 5 to 8 hours of battery life. Powered by a 133- or 150-MHz Pentium, the Nuovo weighs 7 pounds and comes with an 11.3-, 11.8-, or a 12.1-inch TFT or DSTN LCD screen.

Future System

The 1997 version of the AcerNote Nuovo will be based on the 166- to 200-MHz P55C with MMX. It will come with a 12.1-inch TFT LCD with 800- by 600-pixel resolution. Models will offer 2 GB of storage, Fast IrDA, CardBus, and an internal modem.

The 430TX supports several desktop-like features: USB, DMA-33, SDRAM, and, perhaps down the road, RAMbus DRAM. The 430TX is a two-chip solution. The north-bridge portion is the controller, while the south-bridge part is the I/O.

Late in 1996, Intel was expected to ship a Pentium Pro–based module for notebooks, code-named Deschutes, which is a die shrink of Klamath. Like Klamath, though, Intel will sell Deschutes in a module form and will include its Voltage Reduction Technology (VRT) for saving power. Intel's module will make notebook design easier and provide an upgrade path to faster MPUs such as Deschutes, Kao says. All a designer needs to do is tie a connector to the module and buy the I/O part of the chip set.

Why won't Intel sell the north-bridge portion with the module? "If we did that, we would be selling a notebook motherboard. But we don't want to compete with our customers," Kao says. "What a customer can do to differentiate their products is to buy the I/O, add different skins, and integrate other features onto their systems."

Portable Workstations

Notebook makers are implementing Intel's modular approach. For example, Taiwan's First International Computer (FIC) is looking closely at Deschutes for a line of "portable workstations" that were scheduled to be out late in 1996 or early

Enhanced Multimedia Performance

Intel will put a radical twist in computing when it finally ships its multimedia-extensions (MMX) technology. MMX, a set of 57 new instructions added to the x86 architecture, promises to boost multimedia processing.

Intel is integrating MMX in the code-named P55C Pentium chip, which the company expected to ship in the fourth quarter last year. However, confusion over the implementation of MMX technology recently caused Intel to delay the shipment of the P55C until the first quarter of this year. Intel will also incorporate MMX in the Pentium Pro this year.

In theory, MMX could have a profound effect on computing. Preliminary tests suggest that some multimedia and communications applications could run anywhere from 50 percent to 400 percent faster on an MMX platform, including 2-D/3-D graphics, MPEG, audio, and speech recognition.

Notebook versions of the P55C with MMX will come out during the first half of this year or later, reportedly in 150- and 166-MHz speed grades, sources say. In contrast, Intel will ship Klamath, the first single-chip version of the Pentium Pro, in volumes early this year—three months ahead of schedule. With MMX, however, there appear to be some major barriers. "There are only a few business applications that take advantage of MMX," says Jerry Kao, technical marketing manager of the Mobile Computer division of Intel's Taiwan subsidiary.

"In the short term, MMX will boost power management and battery life, because the new instruction sets reduce the CPU work load. If the processor has more time to be in the ideal stage, the system can save more power—up to 40 percent," Kao says.

Some independent software vendors (ISVs) are working on applications that benefit from MMX. Microsoft is talking about a plan to offer MMX technology in Direct3D API, a set of services for real-time, interactive 3-D graphics.

Structurally, the P55C with MMX is like any other superscalar processor. It has an integer pipeline and a floating-point pipeline, with a dedicated register file for each. Data for MMX instructions must be loaded from memory through the L2 external cache and then into the floating-point register. The real changes in MMX involve its highly parallel operations, done via a technique known as single instruction/multiple data (SIMD).

Designed to enable SIMD operations, the four new data types are packed bytes (8 bytes), packed words (four 16-bit quantities), packed double words (two 32-bit quantities), and quad words (64 bits). The new instruction sets fall into five categories—arithmetic, logical, conversions, transfers, and MMX-specific tasks—that operate on these data types using eight new MMX registers. By operating on a packed-data type, the CPU can perform multiple operations all in one instruction.

The MMX instructions are similar to those in Sun's Visual Instruction Set (VIS) for the UltraSparc microprocessor unit (MPU). However, VIS has more to offer than MMX: 32 new registers, accelerated video decompression, more powerful addressing modes, pixel masking, and a highly specialized set of operations that greatly accelerates motion estimation when compressing MPEG video streams. Still, MMX has a good chance to pick up more ISVs. Last year, Intel licensed MMX to its rival AMD.

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this year, says Ralph Liu, product marketing manager. Code-named Teak, FIC's portable workstation will have a 13.3-inch screen. "For heat dissipation, we will need a heat pipe and an external fan," he says.

Of course, Intel's modular approach supports only one MPU vendor: Intel. Meanwhile, Cyrix is offering a solution for notebooks, the 5GX86, a 586-like MPU that incorporates DRAM, a PCI controller, and graphics on the same IC. However, the 5GX86 is not pin-compatible with the Pentium.

Better Graphics

Faster MPUs, coupled with new multimedia features and videoconferencing, will also bring the notebook closer to the desktop PC. In fact, notebooks are getting many desktop-like, multimedia features: MMX, DVD drives, MPEG-2, 128-bit VGA graphics, 3-D audio and video, Digital Simultaneous Voice and Data (DSVD) modems, and others. There's talk that notebooks may adopt Intel's Accelerated Graphics Port (AGP), a new approach to accelerate 3-D graphics. Originally designed to be a graphics port for desktop systems for now, AGP has transfer rates of 528 MBps and write performance 10 times better than the 133-MBps PCI bus. Overall, these technologies provide some hot applications for consumers.

For example, with a 16-bit Zoomed Video port (ZV port)—or a 32-bit CardBus—and a TV tuner, the notebook could become a portable TV. With its NTSC-out port, the notebook will act as a digital VCR, playing full-length DVD movies. Still, LCD size is one of the roadblocks for these applications. Mainstream markets will continue to embrace 11.8- and 12.1-inch LCDs, while high-end displays are rapidly moving toward a variety of 13-inch models. Beyond that, Sharp and others are developing high-end 14- and 15-inch displays, with SXGA resolutions of 1280 by 1024 pixels. However, it is more likely that these latter LCDs will be incorporated in luggable laptops, says Amos Tseng, hardware design manager for Mitac, a Taiwan notebook maker.

LCDs are also critical for videoconferencing. Decent videoconferencing over the telephone line has been promised for years now, but current desktop systems and notebooks are still hampered by poor audio/video synchronization, skipping, time delays, and other problems. The major issue with videoconferencing over the Internet is the lack of bandwidth.

Featron 6600

Current System

The 6600 is a sleek notebook for multimedia applications. Powered by a 133- to 166-MHz Pentium, the 6600 comes with 32-bit PCI VGA graphics, 1.2 GB of storage, 16-bit sound, MIDI, an IrDA port, ZV port, and Type II or Type III PC Card slots.

Future System

The 1997 version will run CPUs from AMD, Cyrix, and Intel, including the P55C. It will include a 12.1-inch TFT LCD screen, 2 GB of storage, 128-bit VGA graphics, a 10- to 12-speed CD-ROM drive, MIDI, 16-bit and 3-D sound, CardBus, an internal modem, and a pair of bays to let you swap peripherals.

Cost is another issue. Still, Intel and others are working on a $500 videoconferencing system for PCs, which includes Intel's Proshare software, a V.80 DSVD modem, and an analog camera that links to a capture card or a digital camera that plugs into a USB connector. However, the frame rate is a mere 10 frames per second. This in turn is causing notebook vendors to consider integrating ISDN into a notebook to achieve or get close to real-time video at 30 fps. Still, some improved but competing technologies are surfacing in the videoconferencing arena: ZV port and CardBus.

The first wave of notebooks will support ZV port. In theory, the 16-bit ZV port provides real-time, full-motion video data at up to 27 MBps, or 24-bit color at 640- by 480-pixel resolution at up to 30 fps. To do so, ZV port transfers video and audio signals to a PC Card in a Type II slot from a video camera or similar input source attached to a notebook. These signals are sent directly to the graphics memory, bypassing the 133-MBps PCI bus.

However, ZV port may be short-lived, says Derek Brearley, deputy executive of marketing for Taiwan's Twinhead. The

32-bit, 33-MHz CardBus has complete access to the 133-MBps PCI bus for use in video, multimedia, Fast Ethernet LAN cards, and SCSI devices, he says. "If you implement the CardBus, you won't need the ZV port," he adds.

Toshiba, one of the major backers of ZV port, is hedging its bets by implementing both ZV port and CardBus across its notebook lines. "We will be one of the first companies to have CardBus on our platforms, but there are still not a lot of 32-bit cards on the market yet," says Toshiba's Wu.

Getting Connected

Notebooks are getting wired—and wireless. Today's notebooks are embracing USB, which links some 127 peripherals over a 12-MBps network, and, eventually, FireWire, a bus with 100- to 400-MBps transfer rates. Notebooks are rapidly moving toward 10/100-MBps Fast Ethernet networks, 32-bit PCI docking, and other connectivity features.

There are also innovations in wireless systems for remote applications. For example, wireless LANs using 2.4-GHz, spread-spectrum technology hold much promise for PCs, but they have proven to be expensive and slow for now. A PC LAN card for notebooks runs at a mere 1 to 2 MBps and costs $350. For shorter distances, however, 4-MBps fast infrared (IR) technology is moving to the notebook. It provides a handy way to move files between mobile systems and desktop PCs and printers.

WANs provide a framework for more powerful applications. Today's portables are capable of connecting to GSM phones, thereby giving you the ability to send and receive data over a wireless network. GSM, which runs at 900 MHz, is the de facto worldwide standard in cellular transmission—except in the U.S. However, the data rate for GSM is only 9.6 Kbps, making it slow and painful to access information over a network. Still, it's becoming feasible to download data via GSM by using V.42bis data compression, boosting the transmission rate from 9.6 Kbps to 30 to 40 Kbps—a promising sign for notebook users.

Leo Designote 4500

Current System

The Leo Designote 4500 is a multimedia notebook based on the 133- to 150-MHz version of the Pentium. The 4500 comes with a 12.1-inch TFT or DSTN LCD screen, 8 MB of memory (expandable to 48 MB), a 256-KB L2 cache, 32-bit PCI VGA graphics, and 1.2 GB of storage.

Future System

The 1997 version will run 166- to 200-MHz P55Cs with MMX. Late in the year, it will offer a P6-based module. The system will include 128-bit VGA graphics, a 12.1-inch XGA TFT LCD screen, and CardBus. And later versions will go to a 13.3-inch SVGA LCD.

Battery-Life Advances

Some new battery and power management technologies promise dramatic gains in battery life. Notebook makers will use lithium-ion batteries as standard equipment. The lithium-ion technology offers longer life than today's standard nickel-metal-hydride (NiMH) batteries, but it is up to three times more expensive. Still, there's a trend toward "smart" batteries. Temperature, voltage, and current sensors are placed on the battery pack, optimizing the use of batteries and increasing their lives.

Taiwan's Acer takes another approach. Its new Pentium-based notebook, the AcerNote Nuovo, runs for 6 hours or more on just six lithium-ion cells, says Lin. "In most notebooks, there are some parameters you need to set up, such as the timing," he says. "But we use a heuristic approach to power management. In other words, the software learns power management by itself. We use a software algorithm based on a dynamic timing-adjustment system."

There are other developments, too. Microsoft is releasing a service kit to help PC vendors build power management features for portable systems into NT 4.0. Microsoft's service kit is limited, however.

Some vendors are not particularly impressed. "It's a short-term solution," says Lin. "Microsoft may announce NT 5.0 early this year. At that time, they will add more power management features, but still, I don't think NT will be popular for most mobile users."

Changing Form Factors

Aside from the battery and power management technologies, notebook form factors are also changing rapidly. Notebook makers are moving in two main directions: the traditional model design and the so-called thin-and-wide form factor. Digital Equipment, IBM, and Compaq are the pioneers of the emerging thin-and-wide notebooks, but Acer, Twinhead, and others are also developing these units.

There are some major trade-offs with many of the thin-and-wide models. The biggest, perhaps, is the lack of internal-drive options. For example, IBM's ThinkPad 560, which is only 1.2 inches thick, does not have an internal CD-ROM drive

The World's Top Notebook Manufacturers

Top notebook makers in terms of worldwide shipments during the first half of 1996.

Company	Units shipped	Market share (%)	OEM partners in Taiwan
Toshiba	1.031 million	20	None
IBM	509,000	10	A small number are built by ASE
NEC	448,000	9	Some are built in-house, others by FIC
Compaq	428,000	8	Arima, Inventec
Texas Instruments	280,000	5	Acer, FIC
Apple	238,000	5	Quanta, Inventec
Fujitsu/ICL	222,000	4	Acer, FIC, others
Dell	158,000	3	Quanta
Sharp	113,000	2	FIC, Twinhead, some in-house
Others	1.718 million		
Total	5.145 million		

Source: IDC/Companies

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or a floppy drive. Twinhead's Pentium-based Slimnote-7 measures 11.6 by 9.2 by 1.4 inches and weighs 5 pounds. It has an 11.3- or a 12.1-inch LCD and a CD-ROM drive. Twinhead's new offering, the Slimnote-9, is a 1.9-inch-thick, Pentium-level powerhouse that includes an 11.3- or a 12.1-inch LCD, a CD-ROM drive, a 33.6-Kbps modem, and ZV port.

Featron is going in the other direction with a more conventional, modular design. Its new Pentium-level notebook has two expansion bays that can incorporate optional CD-ROM drives, floppy drives, or batteries. Also, there are options to add the latest peripherals, such as a notebook version of a Zip drive or a magneto-optical (MO) drive.

Other companies, including FIC, will hedge their bets and plan to offer several types of notebooks this year: ultraportables, professional multimedia systems, and desktop and workstation replacement notebooks, says FIC's Liu. The AcerNote Nuovo is a modular design based on a 133-MHz Pentium. But Acer will move to 150- to 200-MHz CPUs—and faster chips—this year. "We have one goal in mind: We are trying to replace the desktop," says Lin. "We're getting closer to the desktop in performance and features. Maybe we can equal the desktop in features, but we still can't match the price—at least yet." **B**

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INTERNATIONAL

What's New

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Development tools for Unix and NT, and stereoscopic 3-D image processing.

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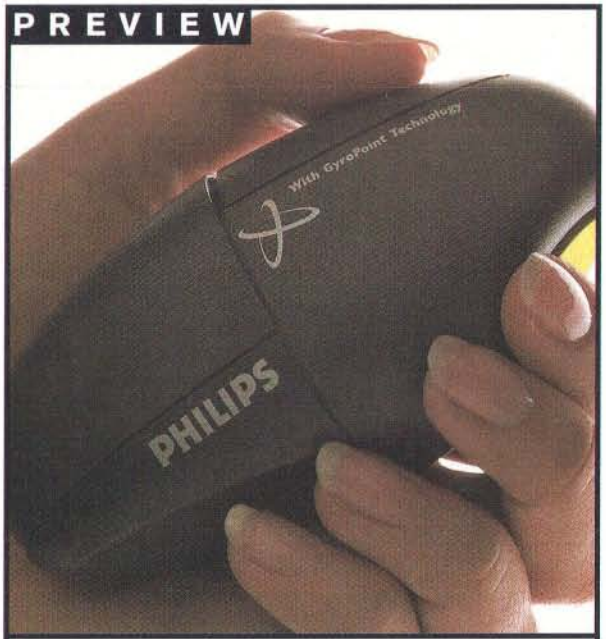

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3D Pointer Pro Brings Movement to Presentations

There's good news if you spend a significant part of your life giving presentations. Philips' 3D Pointer Pro, a wireless, mouse-like input device, lets you freely gesticulate, move about the floor, and at the same time control your presentation screen. A miniature gyroscope translates wrist movements into cursor movements on the screen. The RF receiver connects to the mouse port and enables communications at distances of up to 22 meters.

It takes a few minutes to get used to the fact that you don't need to establish a line-of-sight link, and in the beginning, it is not easy to find the cursor when you need it. However, an "activate" button under the device lets you quickly locate the cursor.

There is no software to install unless you want to use Gyro Tools, which comes on a single disk. Gyro Tools is a set of special-effects software that lets you highlight, underscore, and magnify key points in the presentation. These tools enable 56 special effects. At DM 799, 3D Pointer Pro is not cheap, but professional presenters will soon appreciate being able to move around and click from any position in the presentation theater.

–Bob Emmerson

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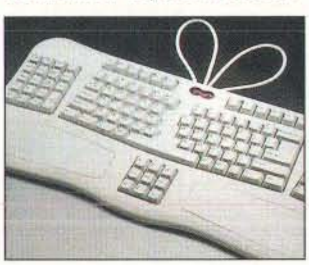

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WITH THE PICPORT IMAGE-ACQUISITION board, you can synchronize up to four cameras, thus enabling stereoscopic 3-D image processing. The device integrates with the PCI bus, and you can use it with a range of image-sensor and camera types. It transfers data to the video memory of the host system at speeds of up to 132 Mbps.
Price: Starts at US$495.
Leutron Vision, Glattbrugg, Switzerland, +41 1 8100676; fax: +41 1 8109440; http://www.leutron.com.
Circle 977 on Inquiry Card.

New PCM Daughterboards

DATA CELL'S SNAPPER RANGE OF IMAGE-acquisition boards includes a PCI Mezzanine Card (PMC) daughterboard with the ability to transfer data to the host system at rates of

up to 133 Mbps. The boards are compatible with the Snapper SDK, which is available under DOS, Windows, and Mac System 7. The PMC daughterboard is available under LynxOS and VxWorks.
Price: Call company.
Data Cell, Ltd., Maidenhead, U.K., +44 1628 415444; fax: +44 1628 415400; kevinr@active.imaging.co.uk; http://www.imaging.co.uk.
Circle 978 on Inquiry Card.

Networking

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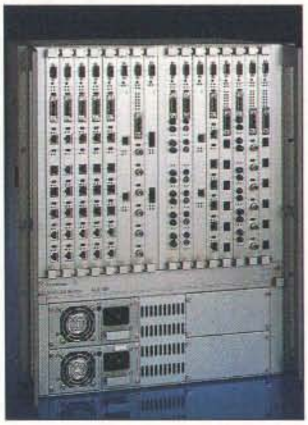
LINKING ETHERNET LAN SEGMENTS TO AN ATM backbone, the switches in the modular ALS family are set to eliminate your LAN bottlenecks. They provide up to 100-Mbps Ethernet ports in a chassis with up to 16 slots. A powerful RISC architecture and a 10-Gbps switching matrix enable operation even under high network loads. All the modules in the ALS family are hot-swappable.
Price: Call company.
Hirschmann Network Systems, Neckartenzlingen, Germany, +49 7127 14 1511; fax: +49 7127 14 1542; n-hi-line @nt-hirschmann.de; http://www.hirschmann.de.
Circle 1112 on Inquiry Card.



Low-Cost Network Adapters

THE KNE40T ETHERNET NETWORK adapters for the PCI bus come in 10Base-T and 10Base-2 versions. They include drivers for ODI for DOS, NDIS2 for DOS and OS/2, and NDIS3, as well as NetWare and Windows NT/95. Additionally, the package includes a configuration and diagnostic utility.
Price: Starts at DM 86.
PSP Pillokat Systeme, Hahnstätten, Germany, +49 6430 2288; fax: +49 6430 2220.
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CD-ROM Drives

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Price: £349.
Chase Advanced Technologies, Bradford, U.K., +44 1274 225000; fax: +44 1274 225020; sales@chase-at.com.
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☐ Windows 95
☐ Windows NT

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Circle 735 on Inquiry Card (RESELLERS: 736).

SOFTWARE

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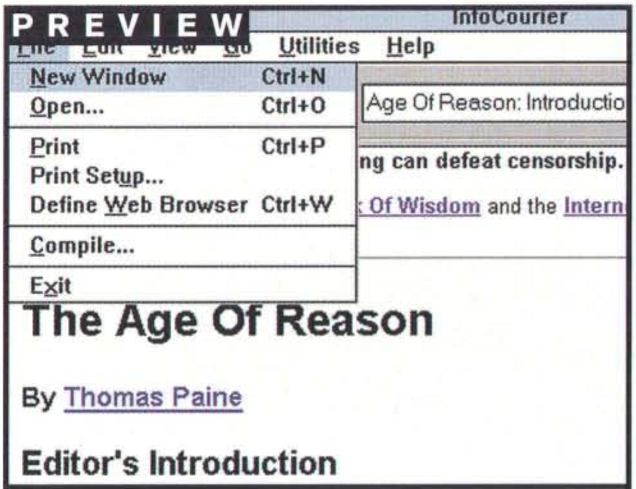
Price: DM 50.
Media Scout Multimedia, Meckenheim, Germany, +49 225 889393; fax: +49 225 889397; order @MediaScout.com; http://www.MediaScout.com.
Circle 990 on Inquiry Card.



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: Of Wisdom and the Intern

The Age Of Reason

By Thomas Paine

Editor's Introduction

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Oakley Data Services
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fax: +44 1889 563219
http://www.smartcode.com

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InfoCourier Compiles HTML into Executable Files

How do you distribute an HTML document to someone who hasn't connected to the Web yet? (There are plenty of standalone PCs out there.) InfoCourier (IC) solves this problem by compiling HTML documents into an executable file, so you can distribute it to such users. When the recipient activates the file, the IC run-time browser displays the pages as if viewing them on the Internet. If, against all odds, the recipient happens to be on-line and has a standard browser, he or she can click on links in the document and view URLs on-line.

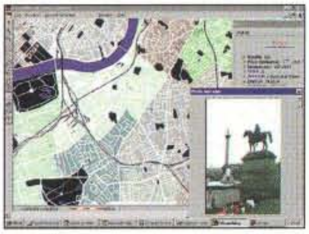
The program enables the author to protect pages against illicit copying or printing, and you can set a time limit on the publication. In addition, you can password-protect certain pages of the compiled document so only authorized people can view them. To compile a publication, you open the HTML-formatted page that you want to be your first home page. You then click on File\Compile and IC does the rest, automatically compiling the home page and all other files in the same directory.

Although IC is a 16-bit Windows program, it accepts 32-character filenames. A free, fully working evaluation copy of the program is available at http://www.smartcode.com or ftp://ftp.smartcode.com.

–Bruce Tober

Tourist Guide Includes Mapping Features

THE VISUALMAP CITY SERIES OF DIGITAL tourist guides integrates a vectorized map and SQL queries for such European cities as Barcelona, Berlin, London, Madrid, Munich, Paris, Rome, and Seville. It helps you find hotels and restaurants and plan sight-seeing trips. You can also measure distances between locations and personalize maps with individual highlights.



Price: DM 70.
Visual GIS, Madrid, Spain, +34 1 372 9920; fax: +34 1 372 8504.
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Price: Call company.
C3 Computer Telephony, Cambridge, U.K., +44 1223 423562; fax: +44 1223 420709.
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Add Mobile-Phone Addresses

THE LATEST VERSION OF WINPHONE (4.1) includes MobiDown, an application that lets mobile phone users download the phone's address book to a PC. MobiDown uses GSM's standard AT-CPB commands and connects over V.24 or PC Card to the PC. It is also capable of selecting just the most frequently used addresses.

Price: DM 50.
Megasoft, Wien, Austria, +43 1 470 2022; fax: +43 1 470 2022 77; herbert @megasoft.co.at; http://www.megasoft.co.at /megasoft.
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Communications

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THE COMFAX FAX SERVER FOR HETEROGENEOUS Windows NT and Unix networks provides least-cost routing and supports ISDN as well as telephone networks. On pure Windows networks, the system integrates with MS Exchange. It also works with OS/2 clients.

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OCTOMAIL GATE IS A MAIL GATEWAY FOR MS Exchange. It lets all e-mail users on a LAN share a single Internet account. The system deploys the POP3 mail protocol, not SMTP, so it offers an individual mailbox for all Exchange users. For dial-up lines, you can configure OctoMail Gate so that it automatically checks e-mail on a regular basis and reports the status of the inbox and outbox. OctoMail Gate also manages message traffic at several

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Development

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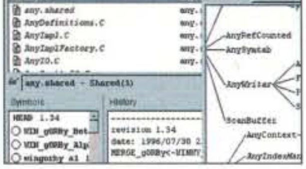

With Sniff+, developers can work in a uniform way in a heterogeneous Unix and Windows NT environment. The system also includes an open-parser API for C, C++, FORTRAN, Java, and CORBA IDL.
Price: DM 5100 (four-user Unix license).
TakeFive Software, Salzburg, Austria, +43 662 4579150; fax: +43 662 4579156; info@takefive.co.at; http://www.takefive.co.at.
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Fast Source Code Parsing

IF YOU NEED TO REENGINEER OR DEVELOP large software projects, Source Navigator, a multiplatform and multilanguage development tool, helps you reduce development cycles. It supports fuzzy parsing and cross-referencing in C, C++, Java, Tcl, and FORTRAN. A symbol and class hierarchy browser lets you efficiently manage existing source code. The vendor says Source Navigator can scan 100,000 lines of code in minutes. It runs under all flavors of Unix and Windows NT/95.
Price: Starts at DM 3000.
CAS, Obertshausen, Germany, +49 6104 98080; fax: +49 6104 980830; info@cas-gmbh.de; http://www.cas-gmbh.de.
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Siemens Anlagentechnik, Erlangen, Germany, +49 9131 746169; fax: +49 9131 725074.
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Spreadsheets

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SGI beefs up the low end of its 3-D graphics workstation line with the power-packed O2. **By Dave Rowell**

Silicon Graphics' Wintel Killer

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The O2 packs lots of video, imaging, and 3-D graphics power into a small, modular package.

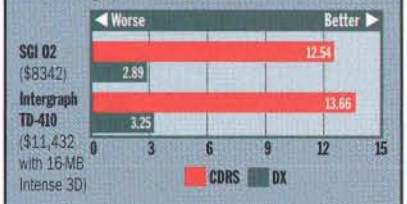
Just when NT-based Pentium Pro PCs are looking like hot 3-D machines (see "Affordable 3-D Workstations," December 1996 BYTE), Silicon Graphics, Inc., introduces the sexy blue O2. Replacing the Indy in SGI's workstation lineup, the O2 is built from scratch to handle complex video and graphics—and street pricing starts below $6000.

In our OpenGL 3-D graphics testing, the O2 ran well against the latest Intel systems. With professional video applications, it should provide an even-better bang for the buck. I was impressed by the O2's ability to distort a live video stream in real time.

The O2 architecture, a unified memory design on steroids, dynamically allocates the system memory among double-frame buffers, a 24-bit z-buffer, and virtually unlimited texture storage, all through a 2.1-GBps memory bus. With independent "engines" for memory control and rendering, display, imaging, compression, and I/O control, the 64-bit 180-MHz Mips R5000 CPU has little left to do.

The memory and rendering engine efficiently gates access to system memory (up to 1 GB of SDRAM DIMMs) with crossbar switching. The rendering component provides hardware acceleration for triangle setup, z-buffering, and textured and nontextured rasterization with up-to-32-bit RGBA graphics modes. The O2's display engine supports up to 1280- by 1024-pixel displays, as well as screen capturing and video-format conversion in real time without CPU overhead.

3-D Graphics Performance



OpenGL performance tested with Viewperf 5.0. Viewperf is single-threaded. Estimated street prices, as tested with comparable configurations (128 MB of RAM, 4-GB hard drive, 17-inch color monitor). Intergraph has dual 200-MHz Pentium Pro processors with 256-KB L2 caches. SGI 02 has single 180-MHz Mips R5000 with 512-KB L2 cache.

The imaging and compression engine performs real-time JPEG for nonlinear editing as well as MPEG-1 hardware decoding. It supports Cinepak, QuickTime, and AVI codecs (but not in real time). With a programmable 66-MHz R3000 integer core, it will handle future formats.

The O2 can maintain simultaneous analog or digital video streams. It also has two wide UltraSCSI channels, built-in 10/100Base-T Ethernet, and a 64-bit PCI slot. An optional $1000 AV module provides the jacks for video and audio equipment, including the O2's digital camera.

Irix 6.3 has a new Web-based user interface, which allows such things as hyperlinks within the extensive on-line documentation. SGI's applications suite lets you edit images, video, HTML, and VRML. Also bundled is Netscape's Navigator 3.0 and FastTrack Server 2.0, as well as Insignia's SoftWindows 2.0.

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★★
PERFORMANCE	★★★★

With price/performance numbers that match or exceed those of NT workstations, the O2 destroys any rationale to leave the SGI camp to run professional applications recently ported to NT. **B**

Dave Rowell is a BYTE senior technical editor. You can reach him at **drowell@bix.com.**

PHOTOGRAPH: BRIAN WILDER © 1997

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

These "private" versions of AltaVista lack the heavy hardware that makes the Web tool such a screaming performer. ***By Steven J. Vaughan-Nichols***

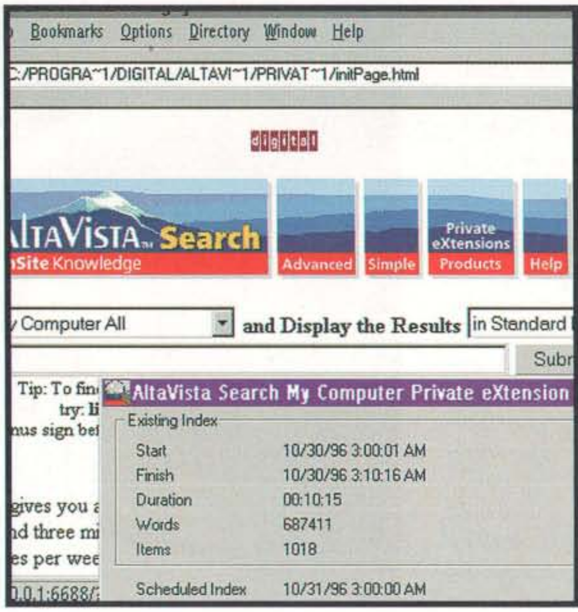
Local AltaVista Searching

Digital Equipment hit a grand slam with its AltaVista Internet search engine (http://www.altavista.digital.com). Now, the company is trying to repeat its success with free-text search programs for PCs, LANs, and intranets. This software family goes by the cumbersome name of AltaVista Search Private Extensions, but the programs themselves are anything but clumsy.

From a marketing point of view, it's an unbeatable idea. AltaVista is, without a doubt, the search engine of choice for the Internet. Practically speaking, however, it's another matter entirely. The problem is that the Private Extensions lack what made their big brother successful—screaming performance, thanks to Digital Unix running on an arsenal of high-end servers. Instead, the Private Extension servers are constructed to run on either Windows 95 workstations or Windows NT servers. In both of these cases, any Web browser can act as a client to the database server.

While it's still too early in the development process to make any hard predictions about the baby AltaVistas' speed, they're clearly not going to be as fast as the server we know and love from use on the Internet. Then again, most of us don't have the luxury of running applications on maxed-out Digital Alpha clusters either.

From your desk, you won't be able to tell the difference between your local AltaVista servers and the Internet server (except for the performance slowdown). The interface looks and feels the same as ever. Behind the front end, the database engine, while taking different roads, works as its Unix elder does. For example, with advanced searches, you use Boolean-style operators—the one odd fish is "AND NOT" for "NOT"—and you can narrow searches by restricting them to particular fields in the automatically generated records.



C:/PROGRA~1/DIGITAL/ALTAVI~1/PRIVAT~1/initPage.html

AltaVista Search My Computer Private eXtension

Existing Index

Start 10/30/96 3:00:01 AM
Finish 10/30/96 3:10:16 AM
Duration 00:10:15
Words 687411
Items 1018

Scheduled Index 10/31/96 3:00:00 AM

AltaVista Search Private Extensions
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Maynard, MA

(508) 493-5111

http://altavista.software.digital.com/

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on Inquiry Card.

Besides letting you use a Web browser, the local AltaVista services come with their own front end.

On the server side, while query results come in at a decent clip, full-text indexing takes a long time. You'd be well advised to run this job in batch mode at an obscene hour of the morning, when it won't impact anyone's real-time work.

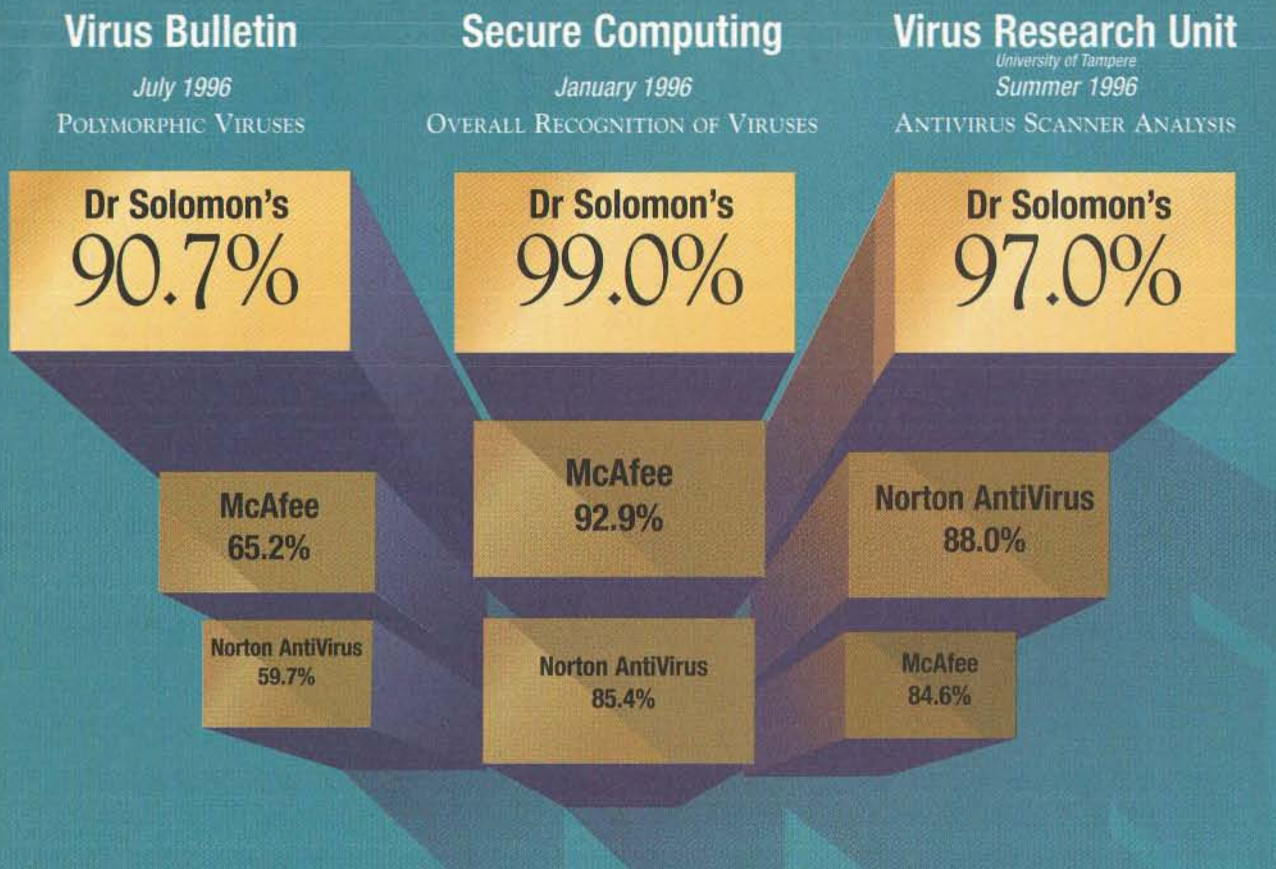
RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★

The only real problem with the new AltaVista spin-offs is that there's nothing new here. Long before the Web was a gleam in Tim Berners-Lee's eyes, askSam Systems (http://www.asksam. com), with its eponymously named free-text database product, was indexing and retrieving data for PCs and LANs. Today, the company's Web Publisher does essentially the same job as AltaVista. What's more, askSam bests AltaVista in the number of file formats it supports.

For example, the AltaVista servers can work with most Microsoft formats, several graphics and spreadsheet formats, and all Hypertext Markup Language (HTML) formats. However, askSam can do all that and adds Lexis/Nexis, WordPerfect, and database formats like the Xbase family's DBF.

Now, make no mistake, AltaVista does a fine job of organizing information from your PC to your intranet. It's just that you should look at other products, rather than simply leaping for AltaVista. You may find that the best-known product is not the best product for your office. **B**

Steven J. Vaughan-Nichols is a freelance writer. You can reach him at **sjvn@bix.com.**



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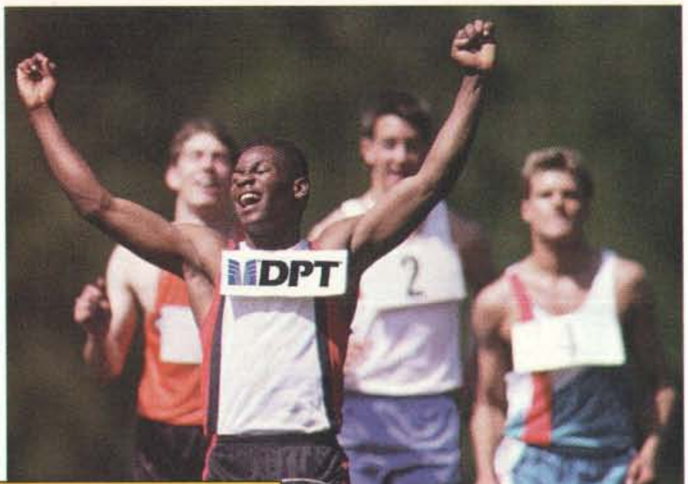

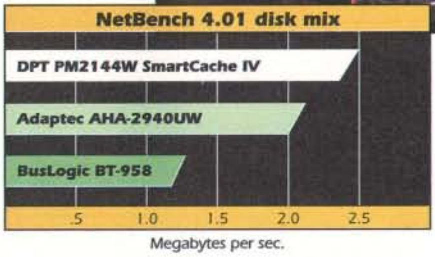

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This chart from the May, 1996 issue of **PC Magazine** (UK) shows the results described in their review of SCSI adapters entitled ***"Survival of the Fastest".*** According to PC Magazine, ***"SmartCache IV was demonstrably quicker than the other two [boards tested]."*** (Adaptec 2940UW and BusLogic BT-958).

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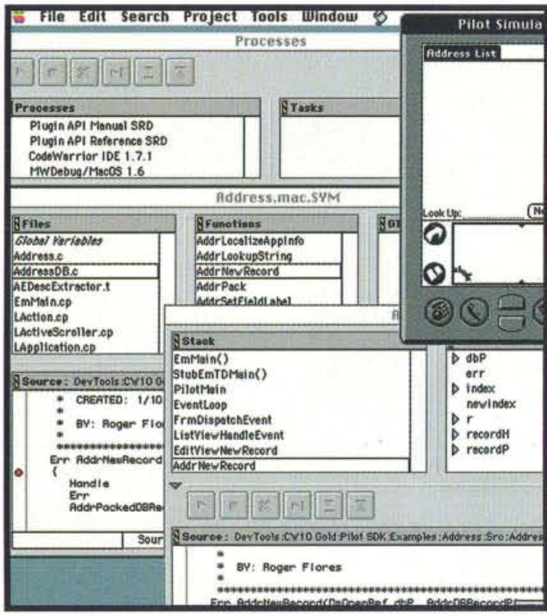
A popular Mac development tool steps out—this time, ready to do battle with a variety of platforms. ***By Raymond GA Côté***

Multiplatform CodeWarrior



CodeWarrior 10
$399
(for 68K or PowerPC Macintoshes; System 7.1 or later required; 16 MB of RAM recommended)

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CodeWarrior now supports development for the US Robotics Pilot PDA, a simulation of which appears in the upper right.

Metrowerks CodeWarrior is one of the all-time great development tools for the Macintosh. The latest release, CodeWarrior 10 (CW10), tackles C, C++, Object Pascal, and Java. Platform-wise, CW10 supports System 7 on 68K and PowerPC Macs.

CodeWarrior is expanding beyond Mac programming with development kits for General Magic's Magic Cap and the new US Robotics Pilot PDA (see the screen). You can also target Windows 95 and NT, BeBox, PowerTV, and Sony PlayStation. As this article was taking shape in early November, Metrowerks announced that at fall Comdex it would demonstrate a Windows version of CodeWarrior. This will let you build 32-bit Windows and Mac applications from the PC side of the world. Other development kits (such as for the Pilot) will appear on the PC as well.

Metrowerks' core technologies are its compilers, linkers, and debuggers. However, the CodeWarrior integrated development environment (IDE) is just as important. Metrowerks has built an extensible IDE, with plug-in compilers, linkers, and pre- and postprocessors. The company provides the API for this IDE as part of the standard development kit. Compiler (and linker) writers who deliver tools as plug-ins to the IDE are able to leverage those powerful core capabilities.

There are, however, some rough spots. Even Metrowerks has not moved all its compilers into the IDE. For example, both the Pilot and the Magic Cap development cycles require that the final product build (the build downloaded to the target hardware) be performed using Apple's MPW command-line environment and a custom Metrowerks compiler. Granted, you can automate this build from within the Metrowerks IDE, but I find having to switch in and out of the IDE during development unsatisfactory.

Pilot Development

I spent some time with Metrowerks' Magic Cap and Pilot development environments. Aside from Magic Cap being based on C++ and the Pilot being based on C, they are fairly similar environments. Both let you link your applications into a simulated environment that runs native on the Mac. Both need a final compile and link phase to be run through MPW. Both let you remotely debug your application on the target hardware.

The simulators permit Metrowerks to leverage the wide assortment of Macintosh development tools. For example, while working on a Pilot application, I can use Jasik's The Debugger and Onyx Technology's QC quality-control tester.

The Wise Route

With the exception of Java, Metrowerks is not attempting to build tools that allow cross-platform application development (that is, a single source-code base simply recompiled for Windows, Mac, etc.). CW10, for example, supports Metrowerks' PowerPlant C++ framework on the Mac and Microsoft Foundation Classes on Windows. Instead, Metrowerks is taking the wise route of providing a core IDE onto which new tools can be grafted, setting the stage for what could be the next standard in development environments. **B**

Raymond GA Côté is president of Appropriate Solutions, Inc. You can reach him via e-mail at **rgacote@apsol.com**.

RATINGS	
TECHNOLOGY	★ ★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Seagate's new Cheetah UltraSCSI hard disk is the first to hit 10,000 rpm. ***By Stan Miastkowski***

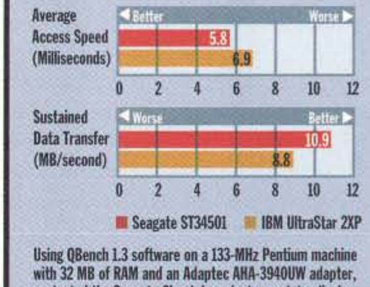
World's Fastest Disk Drive

Demanding PC applications too often run up against hard disks that can't push data fast enough. Seagate Technology has changed that picture with its introduction of the Cheetah line of disk drives. They're the first to bump the standard for high-performance hard drives from 7200 rpm to 10,000 rpm.

I tested an UltraSCSI Cheetah on a 133-MHz Pentium system using an Adaptec AHA-3940UW SCSI card. The results were impressive. The Cheetah was able to transfer data at a continuous rate of nearly 11 MB per second. That's more than enough for the most demanding use. And the Cheetah's embedded-servo technology means the drive doesn't need to perform periodic recalibration that slows down data transfer. This is particularly important for video applications, where even the smallest data interruptions mean dropped frames.

It's not difficult to see why the Cheetahs offer better performance; the faster a drive spins, the quicker it delivers data. The faster rpm rate also means the drive finds data faster. I measured the unit's average access at 5.8 milliseconds. But it's the Cheetah's latency figure (which measures the average time to access the next data called for) that's really impressive. Seagate claims 2.99-ms latency, by far the fastest of any drive available today. By contrast, average latency on high-performance 7200-rpm drives is about 4.2 ms. These seemingly small differences become important when you're pushing a drive to its limits.

Speed Rules



Using QBench 1.3 software on a 133-MHz Pentium machine with 32 MB of RAM and an Adaptec AHA-3940UW adapter, we tested the Seagate Cheetah against an outstandingly fast IBM 4.5-GB UltraSCSI drive that spins at 7200 rpm.

Cheetah ST34501
price not yet available
(4.5 or 9.1 GB; UltraSCSI or Fibre Channel)

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More revolutions per minute drives the Cheetah's latency down to a ridiculously low 2.99 milliseconds.

When first turned on, the Cheetah sounds like a distant jet engine spooling up. But because of special sound-absorbing and sonic-damping materials, the drive soon settles down to a sound level that's little different from other high-end drives. The Cheetah does, however, get very hot after it's been running for a while. You'd be wise to follow the airflow specifications in the manual. Seagate's stated mean time between failures (MTBF), by the way, is 1,000,000 hours—114 years.

The Cheetah uses magneto-resistive heads to pack the data, a 512-KB buffer, and partial-response, maximum likelihood (PRML) read channels that separate that tightly packed data from electronic noise. The drives are compliant with SCSI Configuration Automatically (SCAM) and with Self-Monitoring, Analysis, and Reporting Technology (SMART), so they should be easy to install and maintain.

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★★

The Cheetah comes in 4.5-GB and 9.1-GB models, in both UltraSCSI and Fibre Channel versions. Other major manufacturers will no doubt follow suit and introduce 10,000-rpm drives, but for now, Seagate is the one to buy if you want state-of-the-art hard disk storage. **B**

Stan Miastkowski is a BYTE consulting editor who has been poking around inside computers for almost two decades. You can reach him at **stanm@bix.com.**

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★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

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BYTE

The latest version of this free Unix spans multiple platforms and offers many sophisticated features. ***By Jim Mohr***

The State of Linux

Imagine a Unix server supporting a dozen users connected via serial terminals. Now add a few more users connected across the network using X Window. Finally, let's add a handful of Windows PCs that use the Unix machine as a file and print server. If you think that the machine can't handle this many operations, just add another processor and let the OS perform symmetrical multiprocessing (SMP) to distribute the load. If I were to say that all this is available for free, including the source code, you might think I was joking. If I were to add C and C++ compilers, a text processing system, a spreadsheet, and a Web server to the deal, you might begin to question my sanity. If I were to tell you that most of this software smorgasbord has been available for years, you might begin to question your own sanity and wonder why you haven't checked it out yet.

It's called Linux, and it's a Unix-like 32-bit OS that supports all the utilities, tools, and other features found in commercial Unix products. The latest kernel (version 2.0) provides enhancements such as Java and SMP support, making it better than some commercial Unix offerings. The best thing about Linux is that it's essentially free. However, for this same reason, many people question its legitimacy. Added to the fact that Linux started as a college project by Linus Torvalds, it seems only natural that it would not be something you'd want to run your business on. But as we'll see, the most logical question Linux poses is: "Why not?"

Running Linux

Linux runs on most major processors, such as various species of the x86, the PowerPC family, the Alpha series, and MIPS chips. It supports most major hardware peripherals, with some caveats. Typically, the developers of Linux hardware drivers are Linux users themselves. If someone wants to get a peripheral to work, he or she either writes the driver or waits for someone else to write one. The positive side of this situation is that since the developer uses the device and ends up with the same bugs as you, problems are quickly fixed, usually in a matter of days or weeks. Another advantage to this arrangement is that the person who actually uses the particular peripheral—again, typically the developer—writes the documentation. The negative side of this arrangement is that older peripherals won't garner such devoted support, so finding a reliable driver for vintage hardware, such as an old CD-ROM drive or network card, can be problematic. Furthermore, the person best-suited to write device drivers may be ill-equipped to write clear and user-friendly documentation.

Selected Linux Sites of Interest

URL	Description
ftp://ftp.crynwr.com/pub/kchanges	List of kernel changes, including links to sites with this information
http://sunsite.unc.edu/linux-source/	The Linux Source Navigator. Linux source code in HTML pages. A must for the developer
http://sunsite.unc.edu/mdw	The Linux Documentation Project home page; comprehensive set of on-line documents
http://vortex.cc.missouri.edu/~rhys/linux.html	List of common fixes to Linux problems
http://www.10mb.com/linux/	Home page of The Linux Advocacy Project; encourages commercial Unix application vendors to provide a Linux version
http://www.li.org/linux-int/	Linux International home page
http://www.tu-chemnitz.de/home/linux	Information, including books, links to other home pages (most in German)
http://www.xnet.com/~blatura/linux.shtml	Web Wanderer's List of Linux and Unix resources

The documentation of all commercial Linux distributions appears in the form of HOWTO files. As its name implies, a HOWTO describes how to do something. This can be software related, such as the Firewall HOWTO that describes how to configure an Internet firewall, or hardware-related, such as the CD-Writer HOWTO that describes how to get certain CD-R devices running on your system.

It is important to check if there is a HOWTO for a specific piece of hardware in case it describes problems someone has already dealt with. A good example is the CD-Writer HOWTO. Although there exists a program (cdwrite) that operates CD-R drives, not all CD-R drives work with it. The HOWTO describes how to get the standard SCSI driver to work with specific CD-R drives. Computer-controlled uninterruptible power supplies (UPSes) are another example. Without any direct support from the manufacturers, users have gotten UPSes to work with Linux; their experiences are documented in the UPS HOWTO.

Many of the Linux hardware problems are due to the peripheral being simply too new to the Linux scene, so no driver exists. Other times, changes to the kernel may cause problems to specific drivers. For help, a glance at the Yahoo Web page is a good place to start. For example, when checking the driver status for 3Com EtherLink III Vortex Ethernet cards, I was able to quickly locate patches for the 2.0 kernel, as well as for several other, older releases. The table "Selected Linux Sites of Interest" shows other useful Web sites. There are also sites that provide information in German, Swedish, Czech, French, Italian, Russian, and Spanish.

Perhaps the single most important HOWTO is the Hardware HOWTO. This is the Linux hardware "compatibility list." It describes not only the hardware that is supported but provides tips and URLs for hardware that isn't. "Supported" means only that the standard distribution has drivers for that particular set of hardware. It's always a good idea to check the Hardware HOWTO for a specific peripheral before attempting a Linux installation.

For information on the latest drivers and ports, you should check out the Linux Documentation Project (LDP) home page (http://sunsite.unc.edu/mdw). Aside from providing a full version of various LDP documents or "books," this Web site is a treasure chest of links to the latest drivers and patches, as well as to companies that provide Linux software and complete systems.

Running with Linux

If you're asking, "What good is all this if there is no software to run on it," the answer to that is: There is. Besides supporting all the programs that come standard with a Unix system, Linux supports all the network protocols that Unix users have grown accustomed to, like TCP/IP, NFS, and HTTP. In addition, there is a wide range of free applications software such as a text processing system, a spreadsheet, and a database. If these are insufficient, a wide range of commercial software is available.

Not every software product runs perfectly on Linux the first time. Most noncommercial Linux software is available as source code that you compile on the host system. This increases the likelihood that it will work correctly. However, check the program's accompanying README file that describes what steps to take for specific platforms.

Like the hardware, many software products have their own HOWTO. The Java HOWTO describes the steps necessary to get Java working on your system. Java requires support for Executable and Linking Format (ELF) binaries, which is not available prior to the 1.2.13 kernel. In addition, there are known problems with Java for specific versions of Linux.

A common issue with Linux is its compatibility with other systems. While its interoperability with other dialects of Unix is taken for granted, its connectivity to Windows-based PCs may be a point of concern. Linux works fine as an Internet server, but can it offer the file and printer services that other Unix dialects can? It can if you have Samba running. Samba is a software package that provides the session message block (SMB) functions required to support Windows for Workgroups, Windows 95, Windows NT, and LAN Manager. In fact, any client that supports SMB can access a Linux system running Samba. The great thing about Samba is that it works both ways, so your Linux system can also access other systems such as NT.

Selected Linux Distributors

Company	Linux type	Web site	E-mail
WorkGroup Solutions	LinuxPro	http://www.wgs.com	info@wgs.com
Red Hat	Red Hat	http://www.redhat.com	redhat@redhat.com
Walnut Creek CD-ROM	Slackware	http://www.cdrom.com	info@cdrom.com
InfoMagic	Slackware	http://www.infomagic.com	info@infomagic.com
Debian GNU/Linux	Debian	http://www.debian.org	debian@debian.org
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S.u.S.E. GmbH	S.u.S.E. Linux	http://www.suse.de	suse@suse.de

If you need information in languages other than English, there are a number of places to look. A good start is: http://www.yahoo.com/Computers_and_Internet/Operating_Systems/Unix/Linux/Foreign_Language_Sites/.

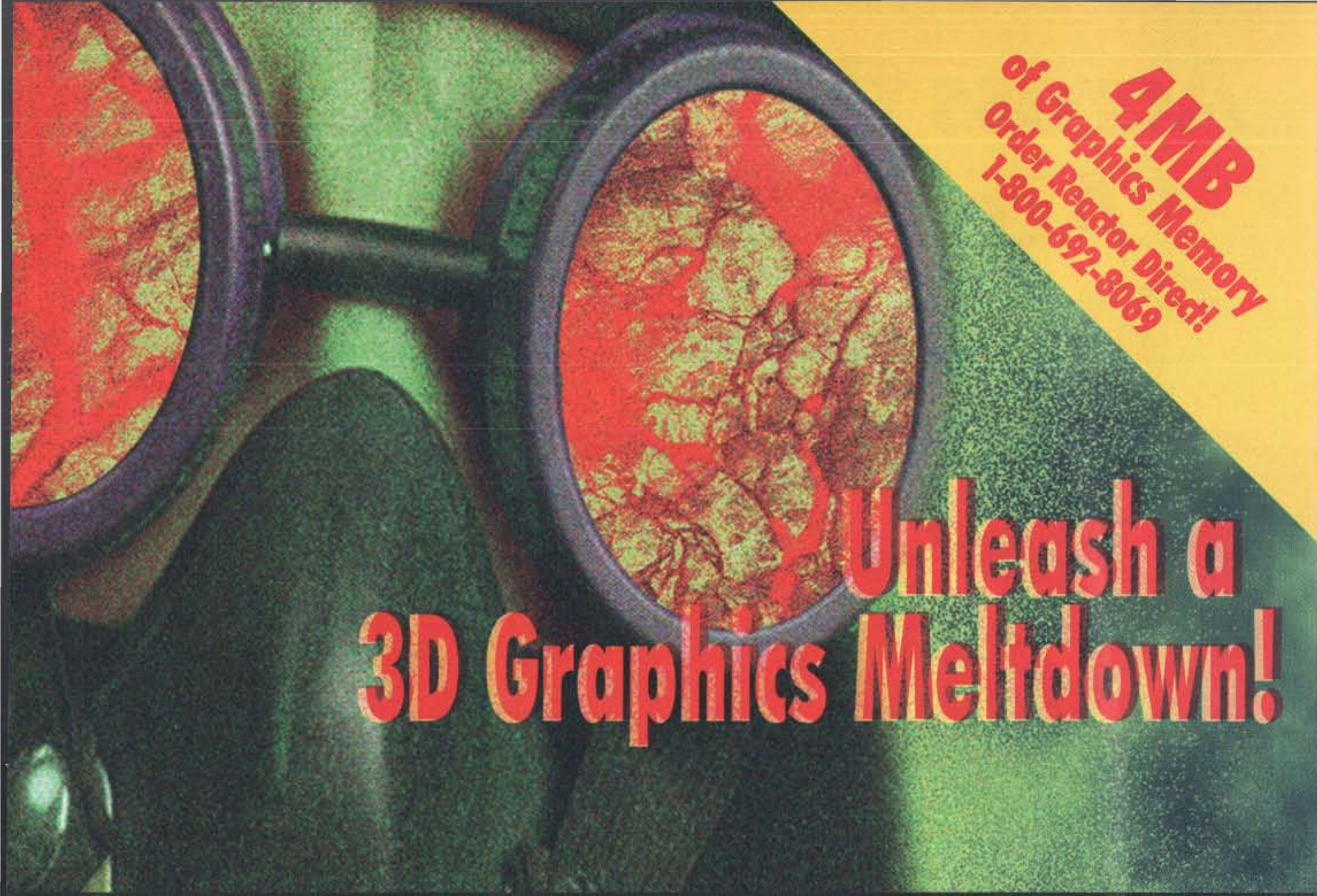
One of the biggest arguments against Linux has been that of support. Because Linux was not developed by a single entity, there is no 800 number you can call. However, Linux is bundled and distributed by a number of companies, as shown in the table "Selected Linux Distributors." If you purchase one of these bundles, you are often provided technical support on basic issues such as installation. Many companies do nothing other than Linux support. Some companies, such as WorkGroup Solutions, not only provide complete systems, including their own version of Linux, they offer consulting services as well. Finally, Linux has developed a very large army of followers able to help since they have experienced the same problems you have.

Industrial-Strength OS

The most compelling aspect of Linux is that it typifies the whole Unix mentality. Unix is a system of choice. You choose how to configure the system and what functions the system has. If you want to implement it on a low-end PC or a high-end workstation, you can. If you need real-time processing, that's available as well. Linux takes this one step further: Not only can you change parameters and configuration as you wish, you can change the basic behavior of the operating system if you need to because you have the source code.

Although Linux doesn't yet run on mainframes, it's just a matter of time. Since Linux runs on every major computer architecture, the odds are that there is a Linux system that fits your needs. Because of the amount of software and support available, Linux has found a place right alongside Unix OSes from even the largest vendors. And you can't argue with the price.

Jim Mohr is a system and network administrator for Kaeser Compressors in Coburg, Germany. He has spent six years providing technical support for SCO Unix and is the author of SCO Companion: The Essential Guide for Users and System Administrators *(Prentice-Hall, 1996). He is working on a book on Linux, to be published this year. You can reach him at* **100542.2677@compuserve.com.**



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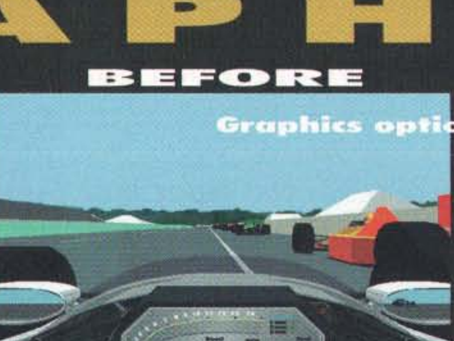

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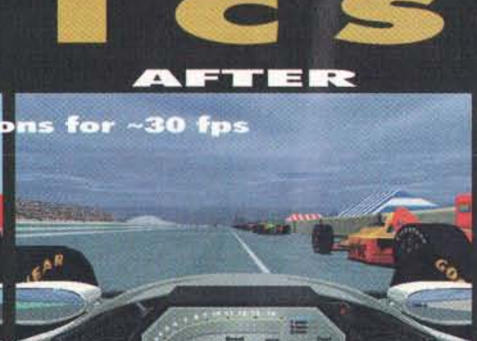

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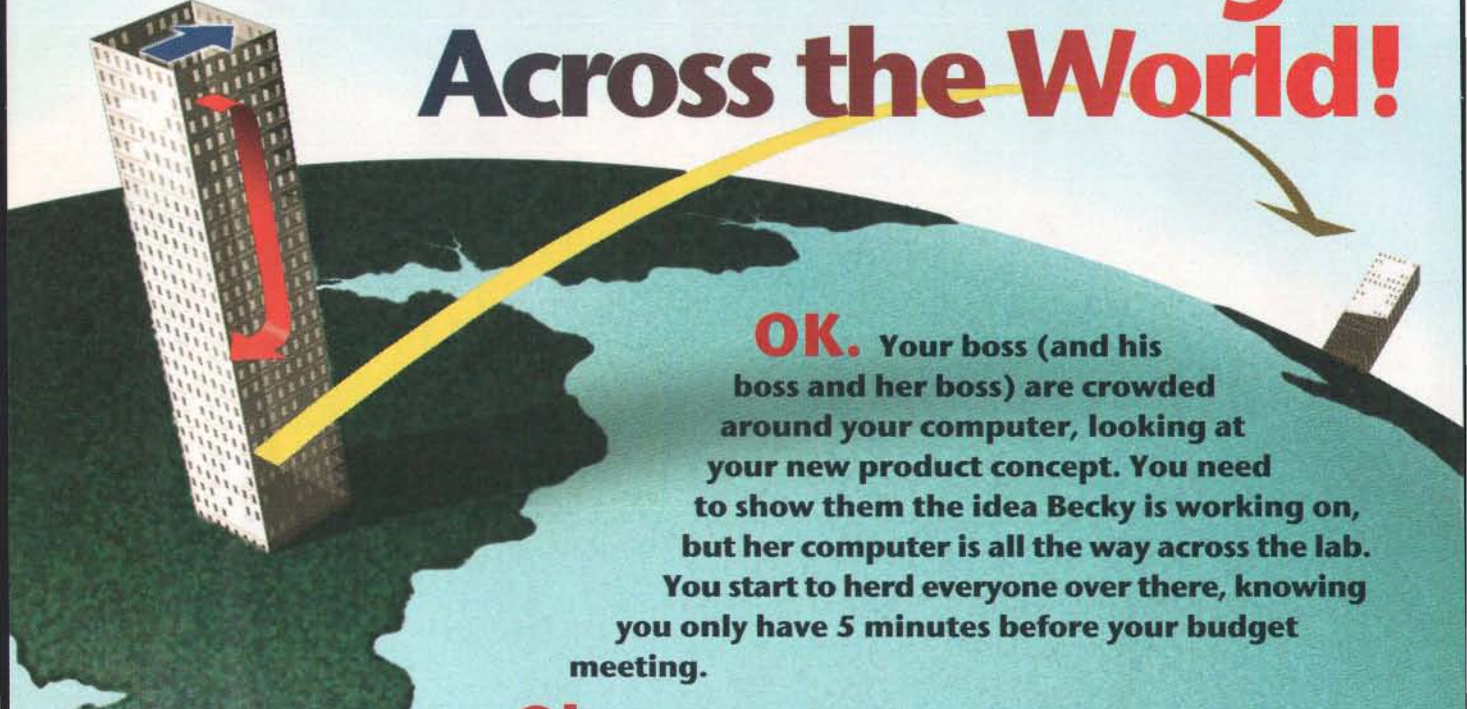

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Remote procedure calls bring network applications together. ***By Tom Yager***

Client/Server Magic

Developers can no longer pretend that their applications run on isolated systems. While today's workers are used to seamless data exchange among applications running on the same system, it won't be long before they demand the same effortless data connectivity across networks.

Every network-capable OS has its pet scheme for passing applications data through network links. Sometimes you can graft one vendor's method onto another vendor's OS. The TCP/IP ("Berkeley") sockets API has taken up with PCs (even those running DOS) and Macs, staying transparently compatible with its Unix birthplace. However, sockets programming takes some time to master. Developers yearn for a simpler, more elegant networking API.

That API does exist. It's called remote procedure call (RPC). RPC was born at Sun as part of its NFS and Open Network Computing (ONC) distribution. The Open Software Foundation (OSF) made a significantly enhanced RPC part of its Distributed Computing Environment (DCE). There is also an emerging ISO RPC specification.

RPC, old or new, comes with most OSes. The focus of this article is the implementation Microsoft delivers with Windows NT Server 4.0. If you're a Unix or Mac user, you should have little trouble applying what you read here to your target OS. Note that Microsoft ships only the RPC portion of the DCE standard with NT. A complete DCE implementation is available in source code from the Open Group/OSF (http://www.osf.org).

Embrace Diversity

NT's version of RPC is sweet. It supports NT's standard networking protocols and can converse effortlessly with clients running DOS; Windows 3.x, 95, or NT; Unix; or the Mac OS. Data knows no platform preference, because RPC smooths the data representation, such as byte ordering and INT size differences. As long as both client and server speak DCE RPC, all lines are open. The Win32 Software Development Kit (SDK) includes the tools and header files needed to support RPC, and Microsoft's Visual C++ development environment supports and documents RPC development.

Microsoft-Supported Network Protocols

Protocol name	Description	DOS	Win 3.x	Win 95	Win NT	Mac	Unix
ncacn_nb_tcp	NetBIOS over TCP	C	C	N	C, S	N	N
ncacn_nb_ipx	NetBIOS over IPX	C	C	N	C, S	N	N
ncacn_nb_nb	NetBEUI	C	C	C, S	C, S	N	N
ncacn_ip_tcp	TCP/IP	C	C	C, S	C, S	C	C, S
ncacn_np	Named pipes	C	C	C	C, S	N	N
ncacn_spx	SPX	C	C	C, S	C, S	N	N
ncacn_dnet_nsp	DECnet	C	C	N	N	N	N
ncacn_at_dsp	AppleTalk	N	N	N	N	C	N
ncacn_vns_spp	Banyan Vines	N	N	N	C, S	N	N
ncadg_ip_udp	Datagram UDP/IP	C	C	N	C, S	N	C, S
ncadg_ipx	Datagram IPX	C	C	N	C, S	N	N
ncalrpc	Local procedure call	N	N	C, S	C, S	N	N

Each protocol's OS support is shown with a C for client support, S for server support, and N for no support.

In describing RPC, it helps to start with a broad brush and work down to the detail. A one-line summary of RPC is that it lets you call virtually any C function from across a network. If you let RPC do all the work, your client code simply makes ordinary function calls, even though the target function resides and executes on a remote server. You can pass arguments from client to server, and the server can send back return values.

The server can even modify data that is passed as arguments, just as a local function can. You can pass pointers, structures, and unions as data. RPC takes care of sending the data, making the call, and returning the results.

If your network is running an RPC directory service (DCE defines its standard Cell Directory Service [CDS]; NT includes Microsoft's proprietary RPC Locator), the client searches the directory for a server that is offering the requested function. A server can upgrade its functions and still remain compatible with older clients. Each RPC interface (group of functions) is tagged with a version number. The server invokes the function with the matching version number, or it refuses the request if a version is no longer supported.

In the NT environment, a server can make an RPC function available to all types of network clients simultaneously. That means one server application can advertise its functions to TCP/IP, Microsoft NetBIOS, NetWare IPX/SPX, and AppleTalk clients. The table "Microsoft-Supported Network Protocols" shows the OSes that offer RPC and which protocols they support.

Fetch the Marshal

RPC's programming interface is partly implemented in a way not often seen today: as a C-code generator. There are libraries and header files, of course, but RPC's simplicity comes from its generated code. Every RPC application is tagged with a Universal Unique Identifier (UUID), which is derived randomly as the first step of code generation. This is part of the identification string that servers register with the directory service. Clients searching for a server must supply a registered UUID, interface name, and version number to get a match.

The RPC code generator works from a template written in the RPC interface definition language (IDL). Microsoft made its mark with some enhancements, turning IDL into MIDL. "Sample MIDL Listing" shows a MIDL file that defines the UUID, version number, and interface name for the application. It also defines the data that passes between client and server through expanded C-style function templates.

Earlier implementations of RPC permitted one outgoing and one incoming data structure. DCE RPC permits any number of function arguments. Each argument can send data to the server (`[in]`), return data to the client (`[out]`), or both (`[in, out]`). MIDL files can contain quite ordinary-looking C variable definitions, even `typedefs`. You can use any data types that are defined in the MIDL file as arguments and return values in RPCs.

The MIDL compiler takes in the MIDL definitions and churns out *stubs*, the C source code that does RPC's hard work. This includes three files: a server stub, a client stub, and a header file. Using RPC's simplest model, you need only compile your stubs to object files and then link those objects into your code. You link the server stub with your server application and the client stub with your client application. You include the header file in both client and server to import the data definitions and to gain access to the RPC API.

The stub code converts data for transmission through marshaling and unmarshaling operations. When a client calls a server, the client stub marshals the arguments by combining the data and converting numeric information into an architecture-independent Network Data Representation (NDR). When the server receives the data, the stub breaks apart the incoming arguments and converts NDR-encoded numerics back to the host's native format. The server calls the requested function, and the server stub then marshals modified (`[out]`) arguments and the return value for transmission back to the client.

Sample MIDL Listing

After the header, the MIDL file follows C-language conventions with some extensions.The RPCDemo function prototype shows one string argument passed to the server, one string shared by the client and server (the server may modify it), and a Boolean (`true/false`) return value.

```
//file RPCDemo.idl
[
uuid(7a98c250-6808-11cf-b73b-00aa00b677a7),
version(1.0),
pointer_default(unique)
]
interface RPCDemo
{
  const long MAX_LEN = 255;
  typedef [string] char pszArg1[MAX_LEN + 1];
  typedef [string] char pszArg2[MAX_LEN + 1];

  Boolean RPCDemoProc(
     [in] pszArg1,
     [in, out] pszArg2
  );
}
```

Ties That Bind

When you're building an RPC application, you must choose a binding method. This determines how the client locates the remote call on the server. Automatic binding takes care of everything. The server can advertise itself on all protocols simultaneously. The client consults its configured directory service (RPC Locator or CDS) to find the server it needs. It lines up matching network protocols, marshals the arguments, makes the call, and unmarshals the returned data with practically no effort. Furthermore, a connection based on automatic binding can often automatically retry a call that fails due to a temporary network outage.

Implicit binding gives your client access to a binding handle. Calls in the RPC API use this binding handle to identify and manage the server connection, but the stub code holds the handle for you. If you choose explicit binding, your client is responsible for the binding handle and must pass it as an argument with every remote call. Implicit binding exposes more of the RPC API, while explicit binding lets a single client maintain connections with multiple servers.

Of the three binding methods, automatic binding is clearly the slowest one. It exacts enough of a performance penalty to force you to use another method for frequent calls or performance-critical code.

While it's a little slow, automatic binding creates the shortest, most easily understood code. The sample code (which is available at http://www.byte.com/art/download/download.htm) includes a Visual C++ make file, a MIDL file, and client and server code for a simple RPC application. The server is written for NT, but the client can run on any version of Windows. If you run the client under Windows 95, check the readme file for instructions on modifying the registry to point to an RPC Locator or CDS on your network. **B**

Tom Yager is a freelance writer and senior software developer in Dallas, Texas. You can reach him at **tyager@maxx.net.**

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Video Input Bandwidth	250 MHz	230 MHz	200 MHz	200 MHz	135 MHz
Maximum Resolution	1800 x 1440	1600 x 1280	1600 x 1280	1600 x 1280	1600 x 1280
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USA **BYTE MAGAZINE** June, 1996

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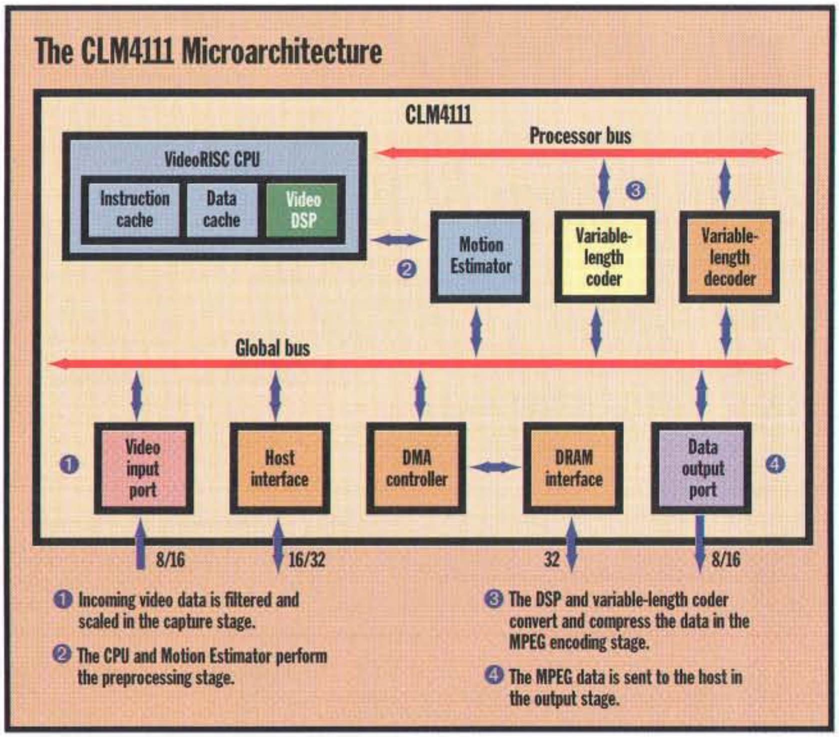
C-Cube Microsystems' low-cost MPEG encoder brings digital video to the mainstream computer user. ***By William Chien***

Video for Everyone

Until recently, the use of MPEG—a standard for the storage of high-quality digital video—as a data type on PCs was limited. That's because while decoding MPEG data is easy—software can convert it back into a digital video stream—encoding live video into the MPEG format requires dedicated and expensive hardware. This restricted PCs to being playback devices for MPEG data.

However, that situation is about to change. Low-cost encoder processors from C-Cube Microsystems capture live video and convert it into MPEG-1 data in real time. One of these encoders, the CLM4111, lets OEMs turn standard PCs into true video-processing engines. Thus, you now can create high-quality MPEG videos for presentations, training videos, and communications on the Internet.


The CLM4111 Microarchitecture

① Incoming video data is filtered and scaled in the capture stage.

② The CPU and Motion Estimator perform the preprocessing stage.

③ The DSP and variable-length coder convert and compress the data in the MPEG encoding stage.

④ The MPEG data is sent to the host in the output stage.

Because of little overlap in chip resources, most of the MPEG-encoding stages can execute in parallel.

CLM4111 Architecture

The CLM4111 performs all the processing required to turn uncompressed digital video from a video-capture device into an MPEG-1 video data stream. To provide this capability at low cost, C-Cube took a programmable approach, enhancing a 32-bit RISC core, the VideoRISC CPU, with special instructions and hardware coprocessors, as shown in the figure "The CLM4111 Microarchitecture."

The VideoRISC CPU operates at 80 MHz with single-cycle instruction execution. Integrated 1-KB instruction and data caches provide single-cycle access to data for both the VideoRISC CPU and Motion Estimator (ME) coprocessor to reduce stalls.

Besides the standard operations, the VideoRISC instruction set includes single instruction/multiple data (SIMD) instructions. These SIMD instructions perform operations on multiple pixels, and C-Cube widened the CPU's internal data paths and registers to 36 bits to support processing four 8-bit pixels in parallel. The SIMD instructions execute on a dedicated Video DSP (digital signal processor) ALU. Video DSP instructions accelerate filtering, discrete-cosine-transform (DCT) calculations, and the image analysis required for MPEG compression.

Coprocessors and I/O

The CLM4111 has several on-chip coprocessors that boost the data-encoding rate. Operating on 8- by 8-byte data arrays, the ME coprocessor performs the repeated block matches required to find the best motion vector when coding MPEG B and P frames.

The variable-length-coder (VLC) coprocessor performs the final lossless compression stage of the MPEG algorithm. The VLC does a zigzag scan of each data block to order the data for maximum compressibility, followed by run-length and Huffman encoding. The VLC uses ROM-based lookup tables to implement MPEG-1, MPEG-2, and H.261 encoding schemes. The variable-length-decoder (VLD) coprocessor performs the reverse processing necessary to decode an MPEG data stream.

To keep the large amounts of video data flowing through the processor, the CLM4111 has four I/O interfaces. Two 8-/16-bit video interfaces handle digital video data, and each one of these has a 32- by 32-bit first-in/first-out (FIFO) buffer to hold the data. The video input port can interface directly to CCIR-601 signal-compatible video decoders. The data output port can transfer data to the host application asynchronously.

The third interface, a 16-/32-bit host port, is used to initialize the processor and download microcode. The CLM4111 has a message-based API that controls the MPEG encoder and its compression parameters. The host system issues the commands through this interface.

The last interface is a 32-bit DRAM interface that connects to 2 MB of fast page-mode DRAM. The CLM4111 uses this DRAM as a scratchpad to store temporary data during the encoding process. This interface generates the signals necessary to drive the DRAM bank, thus reducing parts in a design. A seven-channel on-chip DMA controller prevents congestion by managing data transfers.

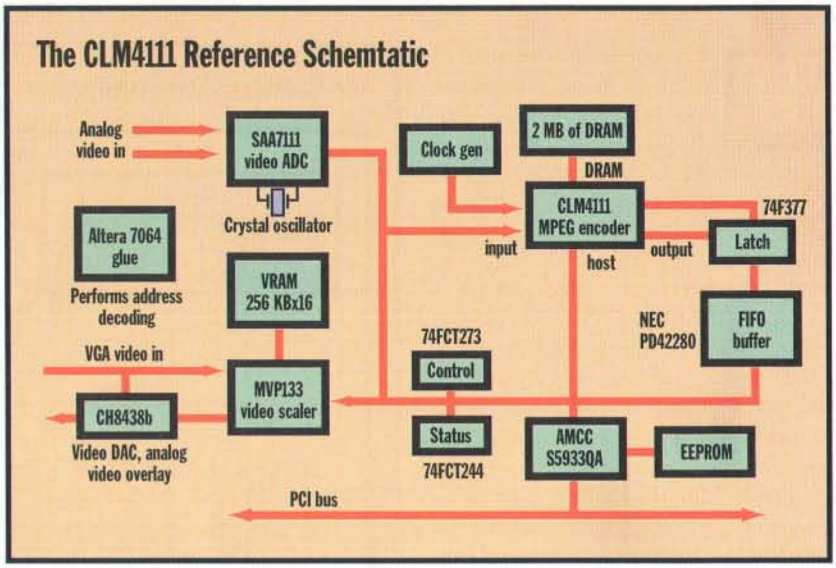
Making MPEG

A description of how the CLM4111 encodes video data shows the complex processing required to achieve real-time MPEG encoding. In the capture stage, the processor receives uncompressed video frames through the video input port. The input interface's hardware performs subsample filtering and 2-to-1 horizontal scaling of the data. The DMA controller transfers the processed data from the input FIFO buffer to a buffer in DRAM.

In the preprocessing stage, the DMA controller transfers frame data to the VideoRISC data cache. The VideoRISC CPU and Video DSP perform additional filtering, scaling to Quarter Source Input Format (QSIF) resolution, and image analysis to determine rate-control settings (i.e., how to encode the current frame with the highest quality). The resulting data is transferred back to DRAM for use in the subsequent encoding stage.

Target and search data are also transferred to the data cache for processing by the ME coprocessor. The resulting best-match information is stored by the VideoRISC CPU in DRAM.

The filtered video data, the ME's motion vectors, and the preprocessing stage's coding instructions are now available for the MPEG-encoding stage. The Video DSP performs the motion compensation, DCT, and quantization on each 8- by 8-byte data block. These results are transferred to the VLC. The VLC unit performs the run-length and Huffman coding of the data, with the output again transferred by the DMA controller to DRAM. In the output stage, the CLM4111 transfers the compressed data frames to the host through the video output port, again under DMA control.


The CLM4111 Reference Schemtatic

The parts to add MPEG editing to a PC cost about that of a quality graphics card.

Microcode Machinations

The CLM4111's microcode manages the overall operation of the processor and implements C-Cube's MPEG compression algorithm. The microcode provides the flexibility to handle different video-frame sizes (SIF and QSIF resolution) and rates (NTSC and PAL). The microcode implements the MPEG algorithm's "smarts," making on-the-fly decisions about how to best encode each frame. The microcode is also responsible for managing the data flow through the processor, such as scheduling DMA transfers and coprocessor execution.

The CLM4111's internal architecture lets the microcode implement a software pipeline. Because most of the MPEG-encoding stages use different on-chip resources, the microcode arranges them to execute in parallel, boosting throughput. Finally, the microcode can program the CLM4111 to perform different functions, depending on the targeted market.

CLM4111 System Design

The CLM4111 is a 3.3-V part, using a three-metal-layer, 0.5-micron process. It's housed in a 208-pin Plastic Quad Flat Package (PQFP). It dissipates only 1 W at 80 MHz. To help OEMs incorporate the CLM4111 into their products, C-Cube provides a reference design, as shown in the figure "The CLM4111 Reference Schematic." Sincee it has a generic host interface and outputs fully compressed MPEG video data, you can connect the CLM4111 to ISA or PCI buses or integrate it on a graphics accelerator board.

The CLM4111 costs $75 in production quantities (i.e., lots of 5000). The reference schematic's estimated bill of materials is $175. These costs are comparable to those of a quality graphics card. The CLM4111's capabilities and price point make it attractive as an add-on for vendors wishing to differentiate their systems. Because the CLM4111 lets you capture, edit, store, and communicate with digital video, MPEG becomes an active data type and useful to everyone. The PC finally becomes an active—not passive—tool for video work. **B**

William Chien is the program manager for the CLM4111 processor at C-Cube Microsystems. You can contact him at **william.chien@c-cube.com.**

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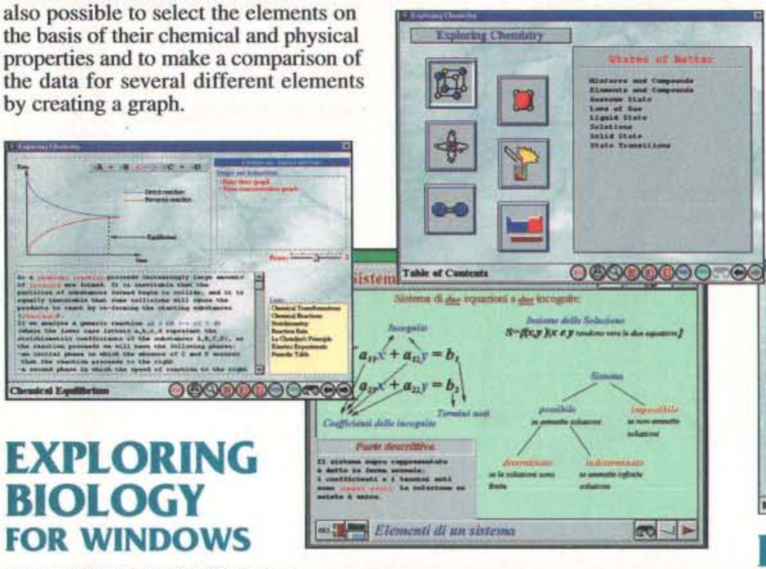

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Java uses a sophisticated class-checking mechanism to ward off breaches in security. *By Gary McGraw and Edward Felten*

Java Security and Type Safety

Java's ability to download, integrate, and execute code from a remote computer is a double-edged sword. On the positive side, the use of Java enables a computer to obtain new capabilities with little user intervention. In addition, Java requires no installation of hard-to-track-down and dubiously secure plug-in files. On the negative side, however, Java's intricate machinations leave a computer vulnernable to attack. A hostile Java applet could stealthily tamper with a host system's files or siphon off private data without the user's being aware of the damage until it's too late.

Java's designers did their best to make such malicious activities impossible by implementing a security model. This security model performs a number of checks before allowing a downloaded applet to execute. (For additional information on Java security, see "Plugs for Java's Security Holes" on page 76.)

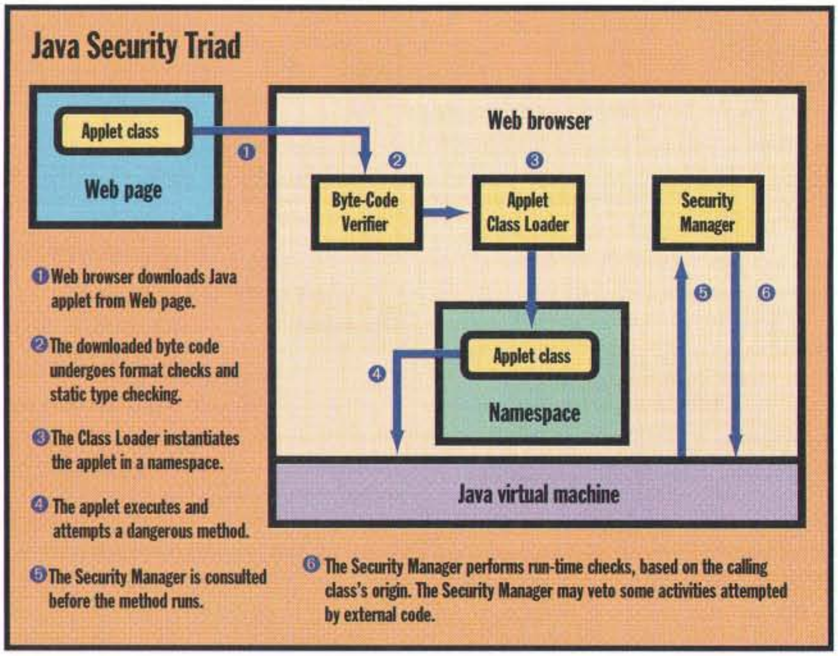
Java security relies on three prongs of defense: the Byte-Code Verifier, the Applet Class Loader, and the Security Manager. Together, these three prongs perform load and run-time checks to restrict file-system and network access, as well as restrict access to browser internals. Each of these prongs depends in some way on the others. Each part must do its job properly for the security model to function correctly.

The Security Triad

The figure "Java Security Triad" above shows how the three prongs of defense fit into the Java framework. The Byte-Code Verifier is the first prong of the Java security model. When a Java source program is compiled, it's converted to platform-independent Java byte code. The Verifier then checks that the untrusted outside code "plays by the rules" before it's allowed to run.

The Verifier checks byte code at a number of different levels. The simplest test ensures that a `.class` file (i.e., a byte-code file) has the correct format. On a less basic level, the Verifier applies a built-in theorem prover to each method. The theorem prover helps ensure that byte code does not forge pointers, violate access restrictions, or access objects using incorrect type information. The verification process, in concert with the definition of the Java language, helps to establish a base set of security guarantees.

Java Security Triad



① Web browser downloads Java applet from Web page.

② The downloaded byte code undergoes format checks and static type checking.

③ The Class Loader instantiates the applet in a namespace.

④ The applet executes and attempts a dangerous method.

⑤ The Security Manager is consulted before the method runs.

⑥ The Security Manager performs run-time checks, based on the calling class's origin. The Security Manager may veto some activities attempted by external code.

Java performs several safety checks before a downloaded applet can execute.

Java's second prong of security defense is the Applet Class Loader. Typically supplied by a browser vendor, it loads all applets and the classes that they reference. When an applet is loaded from the network, the Applet Class Loader receives the binary data and instantiates it as a new class. The Class Loader determines when and how an applet can add classes to a running Java environment. Part of the Class Loader's job is to make sure that the applet doesn't install code that replaces important components of the Java run-time environment.

In general, a running Java environment can have many active Class Loaders, each defining its own namespace. *Namespaces* allow Java classes to be separated into distinct kinds, according to where they originate. In other words, a namespace is a type-safe portion of memory with classes that are associated with a specific Class Loader.

The third prong of the Java security model is the Security Manager, which restricts the ways in which an applet can use visible interfaces. Thus, the Security

Manager implements a good portion of the entire security model. It's a single module that performs run-time checks on dangerous methods, such as those for file or network access or those that define new Class Loaders.

Code in the Java library consults the Security Manager whenever a dangerous operation is about to be attempted. The Security Manager then has a chance to veto the operation by generating a Security Exception. Decisions made by the Security Manager take into account which Class Loader loaded the requesting class. Built-in classes are given more privilege than classes that have been loaded over the network (e.g., applets).

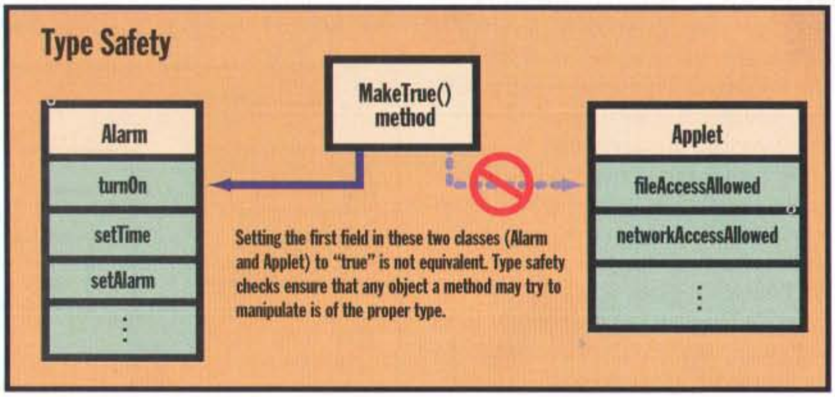
The three parts of the Java security model were created to enforce *type safety*, which means that a program can perform particular operations only on particular kinds of objects. Therefore, Java programs are prevented from accessing memory in inappropriate ways.

More specifically, every piece of memory is part of some Java object, and each object has some class. For example, a calendar management applet might use such classes as Date, Appointment, Alarm, and GroupCalendar. Each class defines a specific set of operations that are allowed to operate on objects of that class. In the calendar management example, the Alarm class might define a `turnOn` operation, but the Date class would not allow `turnOn` to occur.

Why Type Safety Matters

To understand why type safety matters, consider the following, slightly contrived, example. The calendar management applet mentioned above defines a class Alarm, which is represented in memory, as shown in the figure "Type Safety" above. Alarm defines an operation `turnOn`, which sets the first field to true. The Java run-time library defines another class called Applet, whose memory layout is shown in the figure. Note that the first field of Applet is `fileAccessAllowed`, which says whether or not the applet is allowed to access files on the hard disk.

Now suppose that a program tries to apply the `turnOn` operation to an Applet object. If the `turnOn` operation is permitted, the program sets the first field of the object to true. Unfortunately, since the target object is really of type Applet, setting the first field to true allows the applet to access the file system. The applet is then allowed—incorrectly—to modify and even delete files.



Setting the first field in these two classes (Alarm and Applet) to "true" is not equivalent. Type safety checks ensure that any object a method may try to manipulate is of the proper type.

Java ensures that malicious programs can't gain access to system resources.

How Java Enforces Type Safety

Java labels every object by associating a class tag with it. One simple way to enforce type safety would be to check an object's type tag before every operation on it to make sure that the object's class allows such an operation. This approach is called *dynamic type checking*.

Although this scheme works, it's inefficient. Programs end up running slowly because the system spends a lot of time checking class tags. To improve performance, Java uses static type checking, which is more complicated but more efficient than dynamic type checking. *Static type checking* is where the Java system looks at a program before it runs and carefully deduces the results of the tag-checking operations. If Java can figure out that a particular tag-checking operation will always succeed, then there's no reason to do it. The check can safely be removed, thus speeding up the program.

Java's designers carefully crafted the Java language and byte-code formats to facilitate static type checking. Each piece of byte code is a binary representation of an assembly-like language with op codes and operands.

But Java op codes always take type-specific arguments. There are no "generic" operands that take multiple types in the same operand position, as is the case with processor assembly languages.

This, and other properties of byte code, make static type checking easier to implement. The Byte-Code Verifier is an effective static type checker that eliminates almost all the tag-checking operations from Java programs. The result is a program that's type-safe but that runs quite efficiently.

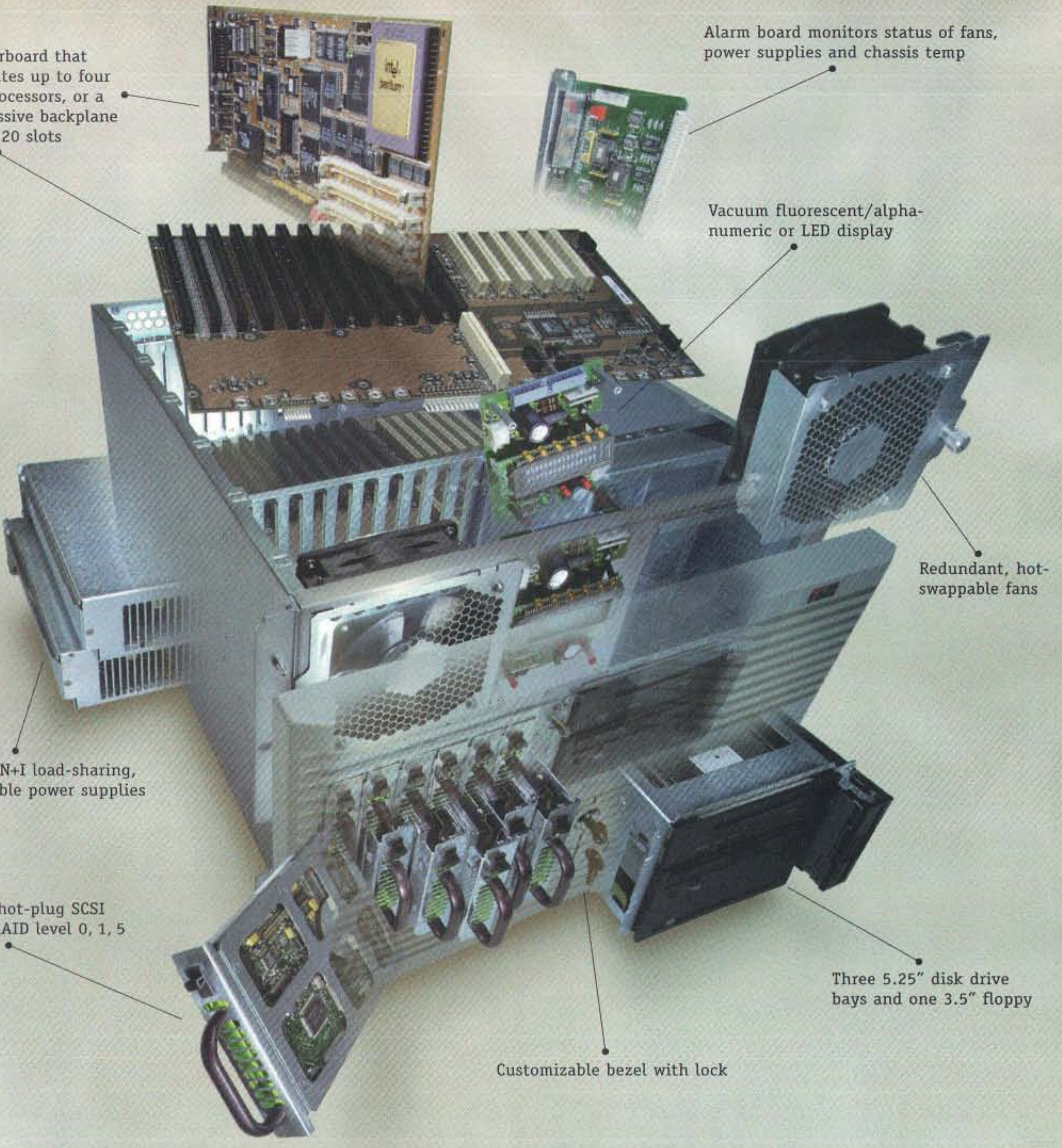
Type Confusion

There is only one problem with Java's static type-checking strategy: It's complicated. Although Java's designers obviously got the overall strategy right, a great many details have to be correct for type safety to be enforced. An error in any of these details leaves a tiny, albeit crucial, hole in Java's type-safety armor.

A clever cracker who finds such a hole can launch a *type-confusion attack*. This is done with a Java applet carefully designed to leverage a tiny type-enforcement hole into a complete system penetration. The attacker can set up a situation like the aforementioned Alarm/Applet example, in which the program has one type of object but the Java system thinks the object has some other type.

Because the Verifier normally prohibits such actions, type-confusion errors are usually the result of bugs in the Java implementation. It is hoped that such problems will disappear as the implementation is debugged and refined. **B**

Gary McGraw, Ph.D., is a research scientist at Reliable Software Technologies Corp. (Sterling, VA). He can be reached at **http://www.rstcorp.com/~gem.** *Edward Felten, Ph.D., is an assistant professor of computer science at Princeton University. He can be reached at* **http://www.cs.princeton.edu/~felten.** *Portions of this article are taken from the authors' book* Java Security: Hostile Applets, Holes, and Antidotes *(John Wiley and Sons, 1996).*



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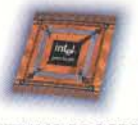

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TODAY the WEB, TOMORROW the WORLD

Is Java a serious programming language? Yes. Will it become a Windows killer? Maybe.

By Tom R. Halfhill

You've heard the hype. You've groaned at the bad coffee puns. Now it's time for the crucial question: Is Java for real?

Straight answer: Java isn't just for building cute Web pages anymore. Java is establishing itself as a serious programming language capable of tackling the most sophisticated business applications. Never in the history of computing has a new language attracted so much support from toolmakers, software developers, and OS vendors in such a short time.

The larger question is, "How much further can Java go?" The answer, incredible as it may seem, is that Java could surpass Windows as the software platform with the world's largest installed base by the turn of the century.

This is possible even in light of five critical Java shortcomings—including an immature security model, slow performance, and a hodgepodge of unpolished development tools—that exist today.

Nevertheless, the key events are already in motion for Java to overtake Windows and cause enormous changes in commercial and corporate software development. The bottom line: All of us who have anything to do with software development ignore Java at our own peril.

See page 40 for exclusive Scott McNealy interview on Java's influence on computing.

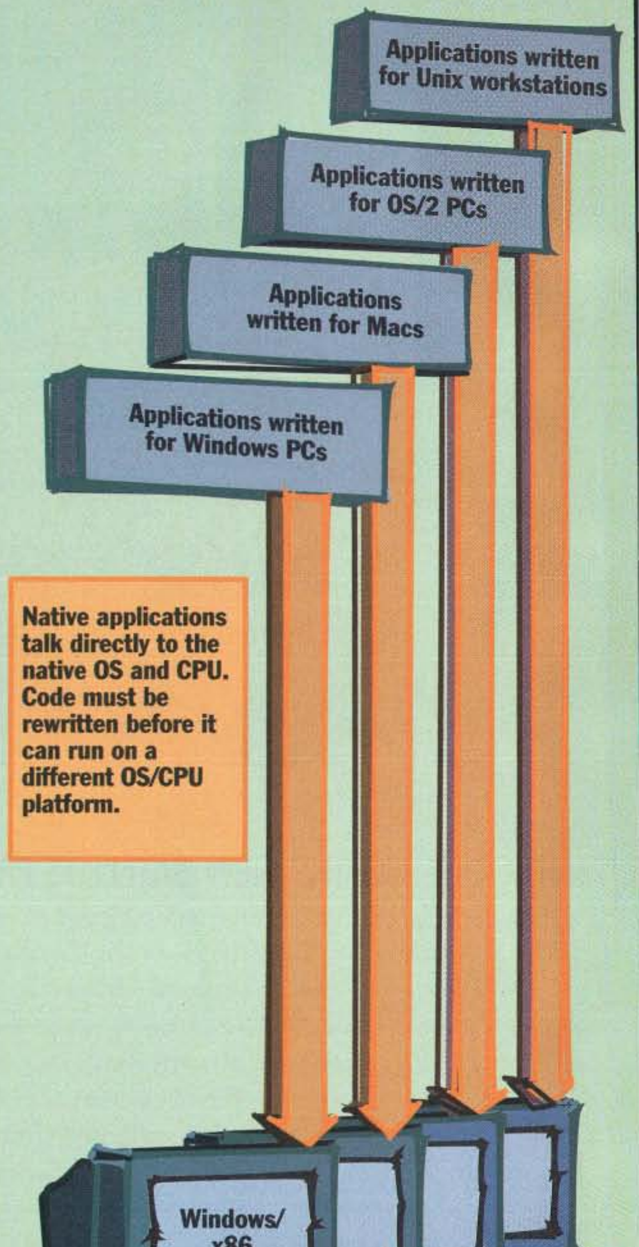
More Than a Language

Java transcends being a language to being a software platform because of the Java virtual machine (VM), which simulates a computer in software. The Java VM can run on existing computers and OSes (e.g., Windows and the Mac OS), or it can run on hardware designed only for Java. Developers who use Java, whether they realize it or not, are supporting a new platform that exists independently of the underlying OS and hardware.

continued

Single-platform application

Today, applications developers write for one platform–often Windows on x86–and port the program to another platform later.

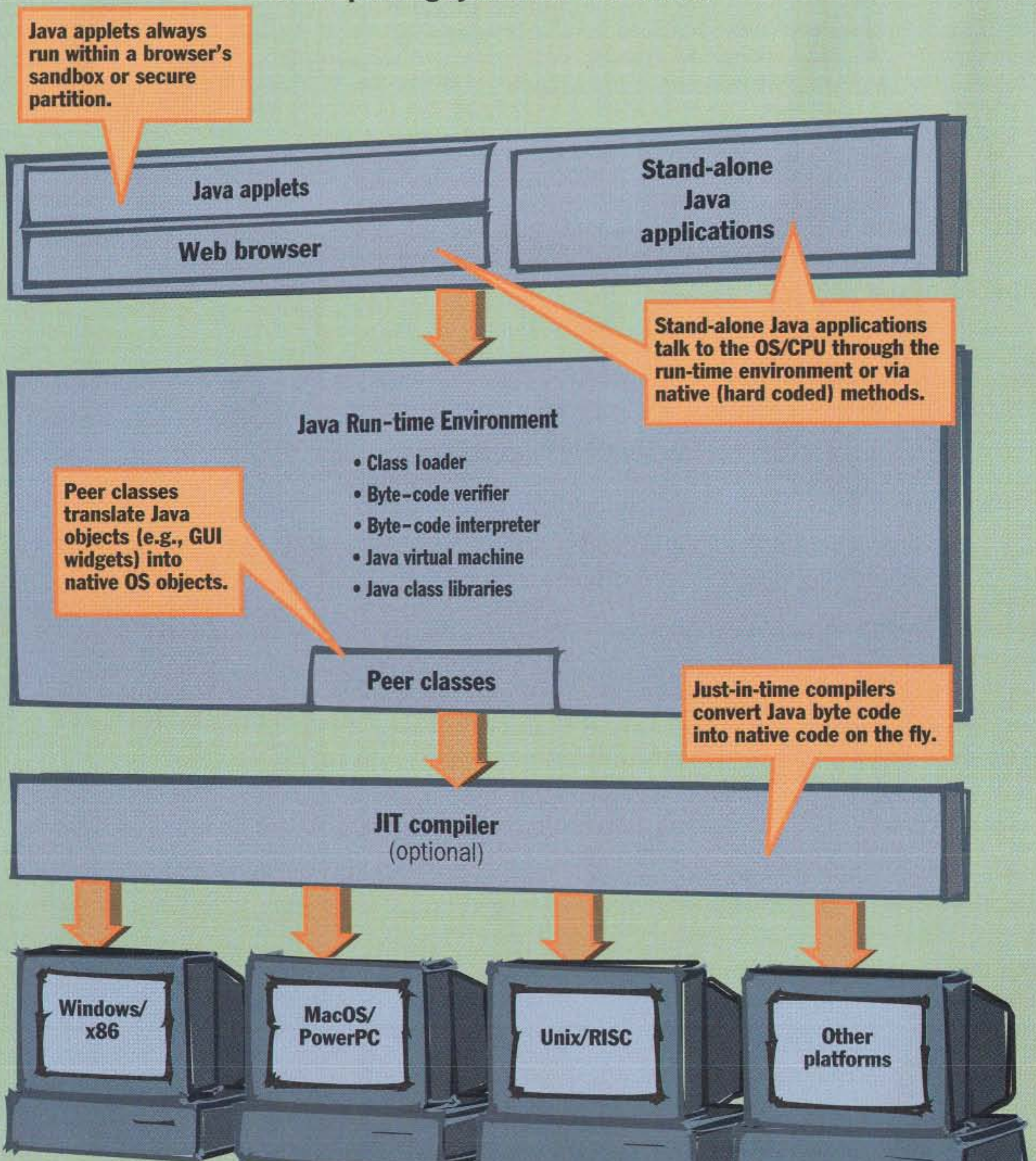

Applications written for Unix workstations
Applications written for OS/2 PCs
Applications written for Macs
Applications written for Windows PCs
Windows/ x86

Native applications talk directly to the native OS and CPU. Code must be rewritten before it can run on a different OS/CPU platform.

The Java Difference

Multiple-platform application

Tomorrow, developers may need to write for only one platform–Java. End-users can run the code on any Java-enabled machine, no matter what operating system and CPU it uses.



Java applets always run within a browser's sandbox or secure partition.

Stand-alone Java applications talk to the OS/CPU through the run-time environment or via native (hard coded) methods.

Peer classes translate Java objects (e.g., GUI widgets) into native OS objects.

Just-in-time compilers convert Java byte code into native code on the fly.

Today, many commercial developers write their software for Windows first, because Windows runs on about 90 percent of the world's PCs. Then they either port their programs to the minority platforms (e.g., Mac, OS/2, and Unix) or ignore them.

If the Java VM someday commands a larger installed base than Windows, developers may write for Java first—and last—because Java software is inherently cross-platform and can run on any system with a Java VM. In effect, Windows would become another minority platform (albeit the largest one) that may or may not justify the extra expense for special support. Java could trigger the biggest platform shift since Windows surpassed DOS—all without forcing you to change your hardware and OS.

The Java Language

Before Java can become a dominant platform, however, corporate and commercial software developers must embrace it as a language. As recently as last summer, many of us were asking if Java was powerful enough for serious software development. Today, that question is obsolete. Consider the following:

- In October, Sun estimated that more than 200,000 professional programmers were using Java.
- According to Sun, one-third of all the enterprise developers at companies with more than 5000 employees use Java.
- Last summer, 11 companies (including Cisco Systems, IBM, Kleiner Perkins Caufield & Byers, Netscape, and Oracle) pooled $100 million to form the Java Fund, a unique venture-capital resource for new Java projects.
- IBM and more than 50 independent software developers announced the San Francisco Project, a plan to build new business applications with Java.

These developments help overcome Java's reputation as a lightweight language for creating decorative Web applets. Look beyond the bouncing heads that enliven Web sites, and you'll see that Java is an industrial-strength, object-oriented language that supports inheritance, encapsulation, polymorphism, multithreading, dynamic linking, and interfaces. It's in the same major league as C++.

Why is Java winning over professional developers, who are notoriously hard to please? Java closely resembles C++, so experienced programmers probably have more to unlearn than to learn. Yet it offers significant advantages over C++. Java makes it easier to write code that's portable, reusable, and bug-free.

Cross-platform compatibility is a tremendous factor in Java's early success. Java compilers (available for Windows, the Mac OS, and Unix) convert Java source code into class files of byte code. The class files correspond to executable binary files generated by compilers for other languages. Unlike native binary files, however, Java byte code isn't specific to a particular microprocessor architecture. Its "native" architecture is the Java VM, which today exists only in software. (Soon, it will exist in hardware as well; see "Sun Gambles on Java Chips," November 1996 BYTE, page 79.)

As a result, Java class files are portable to any hardware platform that has a Java run-time environment. The environment consists of the Java VM, some standard class libraries, a byte-code verifier (for security), and a byte-code interpreter. The interpreter runs the class files on the VM without requiring programmers to rewrite or even recompile their source code.

This "write once, run anywhere" universality is so compelling that some companies are writing their Java development tools in Java so they'll run on any machine. Ignite Technologies' Layout Mill, a visual GUI builder, is one example.

"For the first time, developers can write applications using their Windows people, their Unix people, and their Mac people," says Bill Kelly, president of Ignite. "All of the programmers can work on the same project with the same tool on any platform. This allows developers to hire programmers based on the programmer's expertise with the type of application they want to write, not just the kind of machine they know how to use."

Because Java programs stay within the Java run-time environment, they normally don't interact directly with the native CPU or OS. The run-time environment handles memory management, including garbage collection, so programmers don't have to allocate memory or dispose of leftover objects. There's no need for pointer arithmetic, another major source of bugs in C++. Java has a clean, efficient model for error handling and encourages code reuse because it's object-oriented from the ground up. Java also substitutes interfaces for the complex multiple inheritance of C++.

The Bitter Taste of Java

In the Java world, your code might be bug-free but still not work properly. This is especially true when you test it with a different run-time environment—even another run-time environment on the same computer.

That's because Sun and JavaSoft haven't ironed out all the wrinkles in Java, particularly in the Abstract Windowing Toolkit (AWT) classes that let Java programs use native GUI features. Also, the vendors who license a run-time environment from Sun are primarily responsible for adapting it to their products and to native platforms, and some vendors do a better job of this than others. JavaSoft says testing improvements will mean fewer variations in the future.

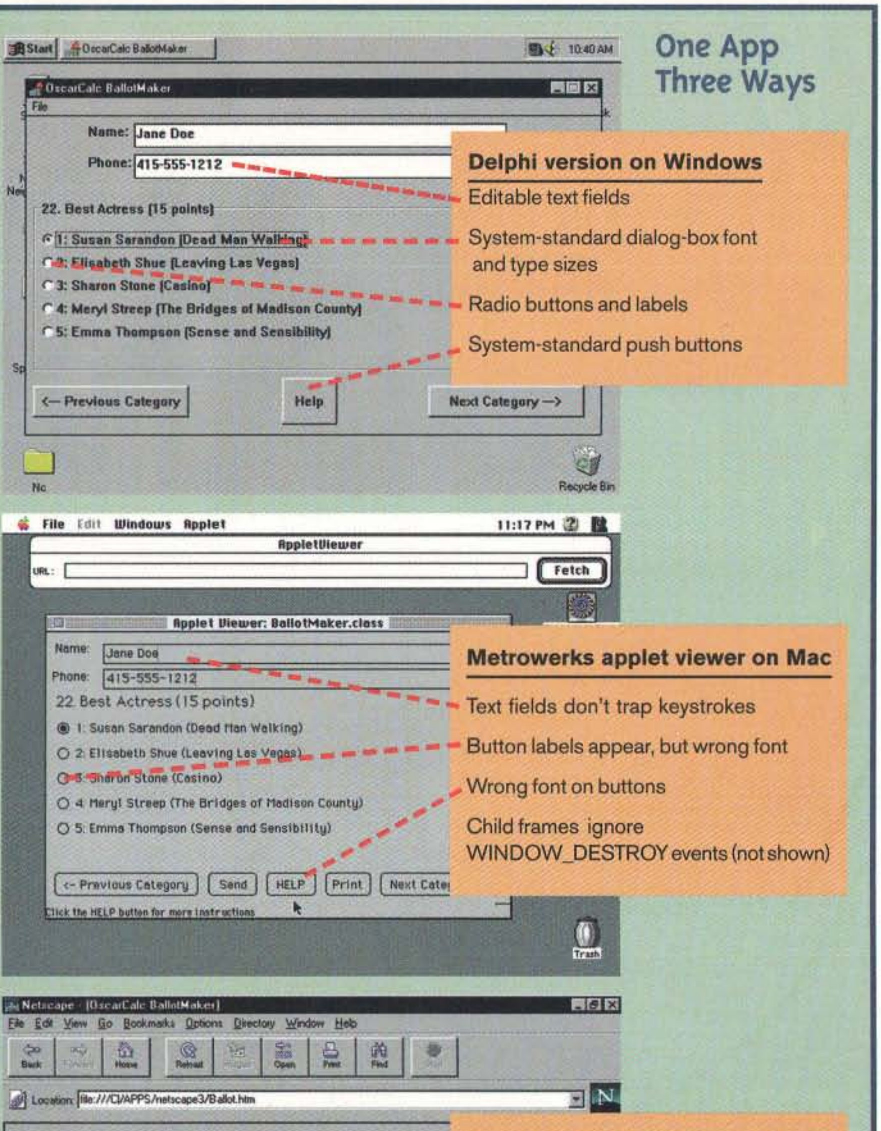
In the meantime, Java pioneers need patience. To get a taste of what early developers face, I wrote a Java version of a program I've already written in three other languages. My project was a data-entry applet for friends who enter my annual Academy Awards contest. Because the applet also provides data verification and back-end processing, it needs more than Hypertext Markup Language (HTML). I've written a Windows version with Borland Delphi (Pascal) and two Mac versions with HyperCard and FutureBASIC.

I developed my Java applet on both a Mac and a Windows PC. All the Java tools I tried—including versions of Symantec Cafe, Microsoft Visual J++, and Metrowerks CodeWarrior—caused problems. They frequently crashed, and their applet viewers either ran my program poorly or wouldn't run it at all. In fact, I had the least trouble when I abandoned those tools, wrote my code with ordinary text editors, compiled it with Sun's free command-line compiler, and tested it with Web browsers.

The accompanying screens show how various run-time environments interpret the same code in different ways. My class files were completely portable—Java lives up to that promise—but the results weren't always what I expected. Some run-time environments completely ignored methods and events in my code, while the identical code ran fine elsewhere.

If you're not comfortable with these kinds of problems, wait for better tools and run-time environments. From what I've seen, things will be a lot more stable in a few months.

According to John F. Andrews, president of CSX Technology, programmer productivity and cross-platform freedom were "key factors" in his railroad's decision to use Java for a massive shipment-tracking application. CSX thinks it's the largest enterprise application yet written



One App Three Ways

Delphi version on Windows

Editable text fields

System-standard dialog-box font and type sizes

Radio buttons and labels

System-standard push buttons

Name: Jane Doe
Phone: 415-555-1212
22. Best Actress (15 points)
● 1: Susan Sarandon (Dead Man Walking)
○ 2: Elisabeth Shue (Leaving Las Vegas)
○ 3: Sharon Stone (Casino)
○ 4: Meryl Streep (The Bridges of Madison County)
○ 5: Emma Thompson (Sense and Sensibility)

Metrowerks applet viewer on Mac

Text fields don't trap keystrokes

Button labels appear, but wrong font

Wrong font on buttons

Child frames ignore WINDOW_DESTROY events (not shown)

URL:
Name: Jane Doe
Phone: 415-555-1212
22 Best Actress (15 points)
● 1: Susan Sarandon (Dead Man Walking)
○ 2: Elisabeth Shue (Leaving Las Vegas)
○ 3: Sharon Stone (Casino)
○ 4: Meryl Streep (The Bridges of Madison County)
○ 5: Emma Thompson (Sense and Sensibility)
Click the HELP button for more instructions

Navigator 3.0 on Windows 95

Text fields detect keystrokes OK

Button labels appear, but wrong font and size

System-standard push buttons

Child frames respond to WINDOW _DESTROY events (not shown)

Location: file:///C|/APPS/netscape3/Ballot.htm
OscarCalc BallotMaker
Name: Jane Doe
Phone: 415-555-1212
22. Best Actress (15 points)
● 1: Susan Sarandon (Dead Man Walking)
○ 2: Elisabeth Shue (Leaving Las Vegas)
○ 3: Sharon Stone (Casino)
○ 4: Meryl Streep (The Bridges of Madison County)
○ 5: Emma Thompson (Sense and Sensibility)

in Java. "Java happened at exactly the right time for us," says Andrews.

Java's much-vaunted portability isn't flawless, however. Sun's JDK 1.0 doesn't fully encapsulate the native APIs of underlying OSes, so Java pioneers must work with a more limited vocabulary of GUI widgets and features. Also, there are numerous quirks in the way different Java run-time environments map high-level objects to native APIs (see the text box "The Bitter Taste of Java" above left).

Growing pains are inevitable with something as spanking new as Java. JDK 1.1, scheduled for release early this year, will fix many of these problems. New Java VMs and development tools are in the works, too. Java is evolving so rapidly it's like the weather in some places—if you don't like it, wait an hour.

The Java Platform

Even if Java becomes nothing but a popular development language, Sun will have scored a big hit. However, Sun—and others—have grander things in mind. Could Java, as a platform, be a Windows killer?

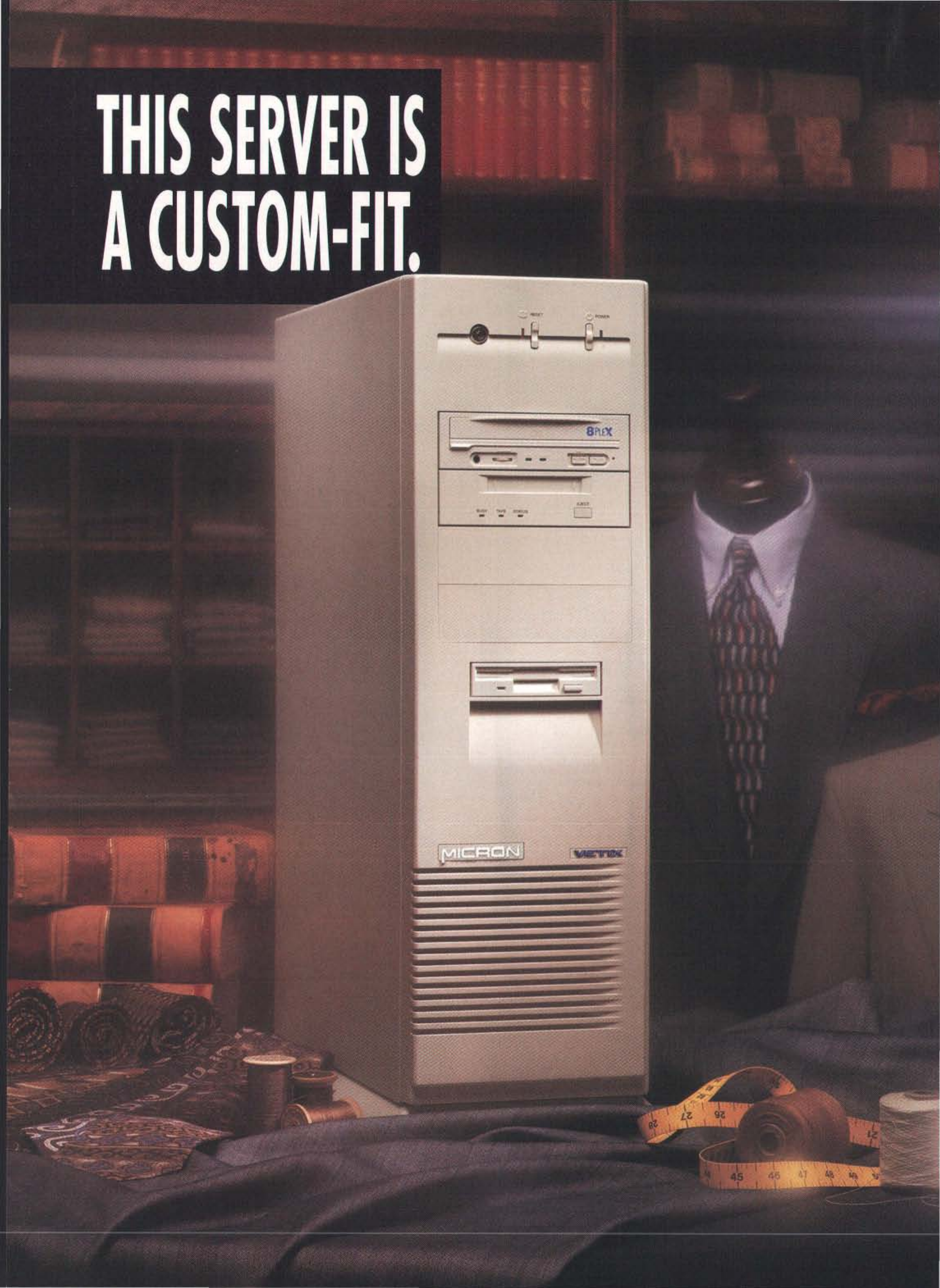
Probably not. But it doesn't have to be. It's important to realize how Java can supersede Windows without killing Windows—or any other platform, for that matter. Java is a stealth platform that propagates entirely in software and coexists peacefully with the native OS.

Other platforms are tied to specific hardware. For every installed copy of Windows, there must be a Windows-compatible PC to run it on. Likewise for the Mac OS, OS/2, Unix, and so forth. There's a little overlap due to emulators, such as SoftWindows and PCs with dual-boot OSes. For the most part, however, the leading platforms add to their installed bases only when someone plunks down a few thousand dollars for a machine.

This is not the case with Java. It's a platform implemented in software that runs on practically any machine, and software spreads much faster than hardware. If you've installed a Java-compatible Web browser, such as Sun's HotJava, Netscape Navigator 3.0, or Microsoft Internet Explorer 3.0, the Java run-time environment is already on your computer. You can also download JDK for free off the Web to make your system a Java platform. Java development tools come with a VM, too. Java isn't self-replicating like a virus, but it's nearly as contagious.

Apple, IBM, Microsoft, Novell, Silicon Graphics, and Sun are paradoxically accelerating the process by integrating the Java run-time environment into their OSes. All of them say their OSes will be Java-enabled within a year. They recognize Java's popularity and potential, and that offering a superior Java run-time environment will give them a competitive advantage. It's good for users because each new Java-enabled application you install won't have to clutter your system with its own VM.

"We think it's critical to establish a good, stable, standard Java VM on the Mac platform," explains Mike Zivkovic, product manager for Apple's Mac OS Java run-time environment. "We are concentrating on stability, stability, stability. That's what software developers tell us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By the end of this year, there will be Java VMs for Windows 95, Windows NT, Windows 3.1, the Mac OS, most flavors of Unix, OS/2, NetWare, and Apple's Pippin and Newton OSes. IBM is even porting Java to the AS/400 and MVS, which manage an estimated 70 percent of the world's corporate data. This is why it's not crazy to predict that by the turn of the century, there will be more copies of the Java VM in the world than any of the OSes that host it.

Note that Java will not replace any of those OSes. Indeed, the Java VM is a benign parasite that cannot run without a host OS. (Sun has a special Java OS, but it's for dedicated Java devices, not conventional PCs.) Far from being a Windows killer, Java actually needs Windows to spread itself on the massive installed base of PCs.

Things will get really interesting if that happens. Sheer numbers will make Java the world's most widespread software platform. Every Java VM will run every Java program that has ever been written or will be written, without porting or recompiling. How will this affect the software balance of power?

It could work to the advantage of minority platforms that currently don't attract as much software development as Windows. Today, developers justify Windows-centricity by explaining that it's simply good business to target the largest installed base. If Java becomes the largest installed base, and developers gradually shift their focus away from Windows, the minority platforms will get much more software. On the other hand, Java could also hurt the minority platforms by robbing them of the special development they receive now—the kind of support that makes them unique and justifies their existence.

This is not just a puzzle for sales-conscious commercial developers. Cost-conscious corporate developers must weigh the benefits of writing for a universal platform, too. David Gee, Java marketing manager of IBM's Internet Division, says Java will revolutionize the deployment of enterprise applications in heterogeneous environments. "It doesn't matter what the server is, it doesn't matter what the client is, it doesn't matter what the network is. That's huge."

Five Reasons to Snub Java

With an upside this big, there has to be a downside. Although it's possible Java will someday be the most populous platform,

JavaBeans: Cross-Platform Components

Yes, JavaBeans are another grating coffee pun. They're also prewritten software components that make it easier to build Java programs.

Beans are to Java what OCX/ActiveX objects are to OLE and Live Objects are to OpenDoc. Some Beans are visual components that you add to forms in visual-development tools; other Beans are faceless objects that do something in the background. A Bean could be a cartoon or a piece of business logic. You could build a simple Java applet by assembling a bunch of Beans without doing any programming, or you could wrap some Beans in thousands of lines of proprietary code to build a sophisticated enterprise application.

Because Beans are written in Java, they have two big advantages: They're cross-platform, and they're relatively easy to write. ActiveX objects and Live Objects are platform-specific binary files that are more difficult to write. (Beans are just specialized Java class files. In fact, all Abstract Windowing Toolkit [AWT] components are automatically Beans, because AWT in JDK 1.1 adopts the new JavaBeans event model. Anybody who has written a visual component that subclasses an AWT object has already written a Bean. Few have accidentally written an ActiveX control or a Live Object.)

ActiveX and OpenDoc supporters often refer to their objects as "cross-platform," but they're really multiplatform: Someone has to port every object to every platform. Some platforms get more attention when it comes time to allocate precious development resources.

Beans are based on existing Java objects, with four new features. JavaSoft defines a Bean as any Java object that implements at least one of these features.

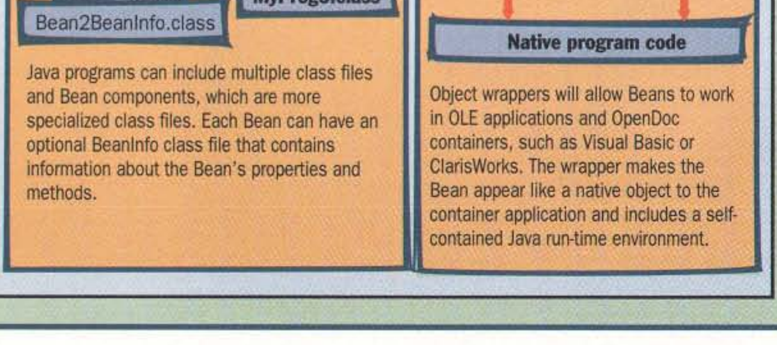
Introspection/reflection lets a Bean expose its data structures to other programs and to programmers. For example, a development tool could have an object inspector that lets a programmer examine a Bean's methods, instance variables, properties, and interfaces.

A new *event mechanism* streamlines event handling and works with AWT components. (Java still supports the existing `handleEvents()` method for backward compatibility.) Because the new model uses less indirection and is more strongly typed, it's much more efficient, especially for high-frequency events like mouse movements.

Serialization/persistence lets Beans permanently remember changes to their properties. Currently, objects always revert to their default properties.

Interoperability lets Beans work anyplace where ActiveX objects or Live Objects can work. You could use a Bean with Visual Basic or in an OpenDoc container such as ClarisWorks. The bridging technology does practically all the work, so Bean authors have to write little or no code to get OLE and OpenDoc compatibility. JavaSoft already has some existing Java applets working with Visual Basic.

Beans will lead to better Java development tools and will open up a lively market for prefab components. They'll also speed up Java's evolution, because third parties can create Beans that fill some of the gaps in Java's capabilities.



Java programs can include multiple class files and Bean components, which are more specialized class files. Each Bean can have an optional BeanInfo class file that contains information about the Bean's properties and methods.

Object wrappers will allow Beans to work in OLE applications and OpenDoc containers, such as Visual Basic or ClarisWorks. The wrapper makes the Bean appear like a native object to the container application and includes a self-contained Java run-time environment.

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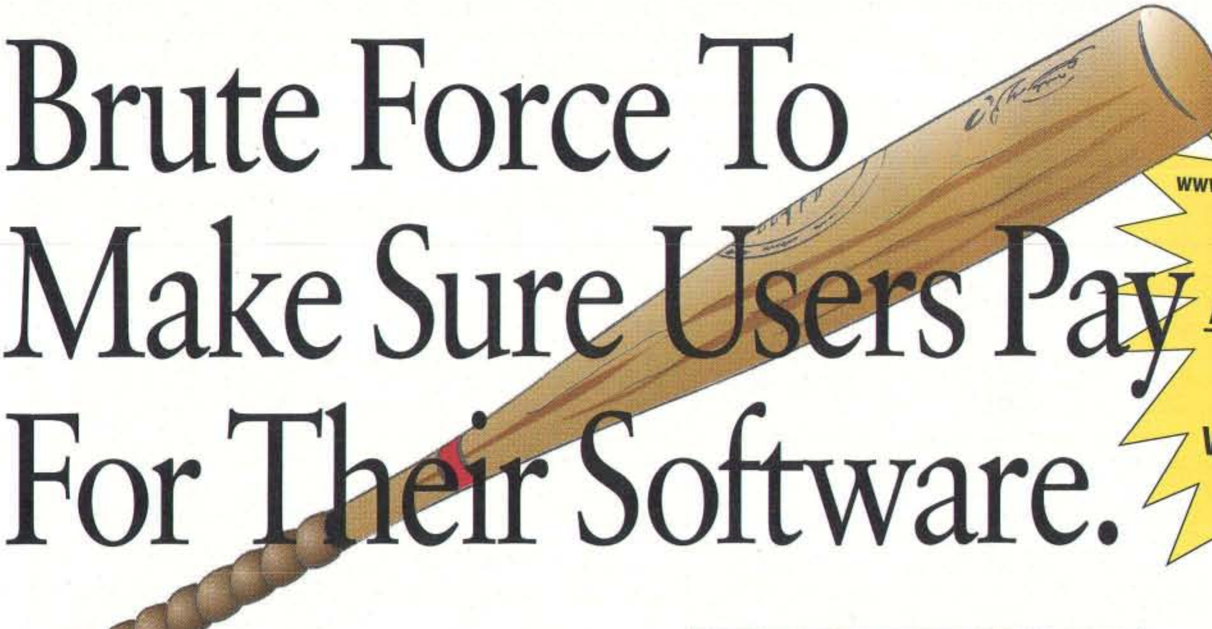

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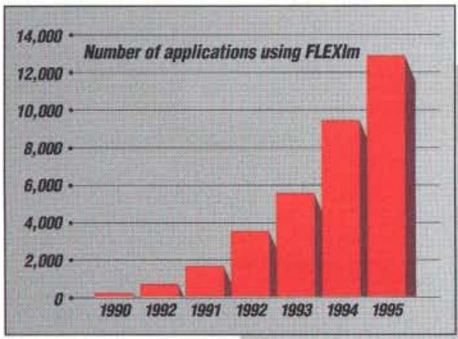

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it won't necessarily be the most popular platform for new software development. Despite Java's benefits, there will still be reasons why a developer might "go native" by writing for the foundation OS:

1. A native OS might offer features that Java can't use without sacrificing cross-platform compatibility.

2. Interpreted Java byte code doesn't run as fast as compiled native code.

3. If a program must interact with legacy code or data, a more established tool or language might work better. (This is an especially important consideration for corporate developers.)

4. A developer may have superior tools for another language or may be more productive using a familiar tool or language.

Plugs for Java's Security Holes

The Java security model is not perfect. Devious developers can create Web-embedded Java programs, known as *hostile applets*, that can make life miserable for Web users. The good news is that JavaSoft's revamped security model, which will evolve over the next year, may shore up Java's current security weaknesses.

Hostile applets divide into two groups: *attack applets*, which cause dangerous security breaches, and *malicious applets*, which are annoying rather than destructive. Although less harmful, malicious applets are insidious because you might load one on your machine simply by surfing to a Web page.

WHAT APPLETS SHOULDN'T DO

Java's run-time processing enforces severe limitations on what applet-related classes can do. Applets, for example, cannot read or write to the disk.

However, an attack applet still could corrupt data on your hard drive, reveal private data to third parties, infect your machine with a virus, or install a trapdoor to your machine. A cracker could attain his or her ultimate goal—complete control of your machine.

To date, we know of eight serious security problems in Java implementations, ranging from Domain Naming System (DNS) name-resolution problems to type confusion. One serious flaw, discovered last August, was in Microsoft's implementation of how Java checked whether a class was allowed to be a member of a particular package. An attack applet could change security parameters and ultimately gain full access to the victim's files and network. This flaw in Microsoft Internet Explorer 3.0 Beta3 was fixed in Explorer 3.0.

These attacks are not hypothetical. Every attack has been implemented by the Safe Internet Programming team at Princeton University (led by one of the authors) to break into a test machine in the lab.

Our analysis demonstrated that attack applets require in-depth understanding of complicated Java and Internet issues to pull off. Nevertheless, it takes only one person to devise a novel attack applet; once loose, information about it would spread quickly throughout the cracker community.

Even the lesser malicious applet can disrupt your local system and invade your privacy. Malicious applets written by miscreants currently can forge mail from you to anyone saying anything, steal your machine cycles to perform their own work while your processes languish, and crash your local system by sucking up system resources. There are also malicious applets created simply to annoy: Play sound files forever, monitor your Web use, and display unwanted graphics.

NEW MODEL

To fight hostile applets, JavaSoft will redo Java's security model over the next year (see "Java Security and Type Safety" on page 63). The first enhancement will appear in JDK 1.1, due early this year. Signed applets would contain the creator's encrypted signature to help determine whether they can go beyond the "sandbox"—the secure browser partition where applets normally run. Trusted applets could read or write to local storage or access a uniform resource locator (URL) other than their own.

Signing is not very robust. It doesn't stop applets from inflicting damage; it just tells you whom to blame. And it's all or nothing: You either trust a signed applet outside the sandbox or you don't.

A better alternative allows finer control over a program. Later this year, you should be able to grant specific permissions to Java programs, choose a different security policy for each program, and even change policies on the fly. For example, you could keep applets in the sandbox unless they originate from a trusted site, or allow some applets to read from (but not write to) local storage devices.

Will these improvements plug all possible security holes in Java? Even JavaSoft's security architect, Li Gong, says it probably won't. "We can't guarantee the security model 100 percent," he says, "[it's] how that model is implemented when it comes to writing the code."

Gary McGraw and Edward Felten are authors of *Java Security: Hostile Applets, Holes, and Antidotes* (John Wiley & Sons, 1996). Tom R. Halfhill also contributed to this text box.

Security Site

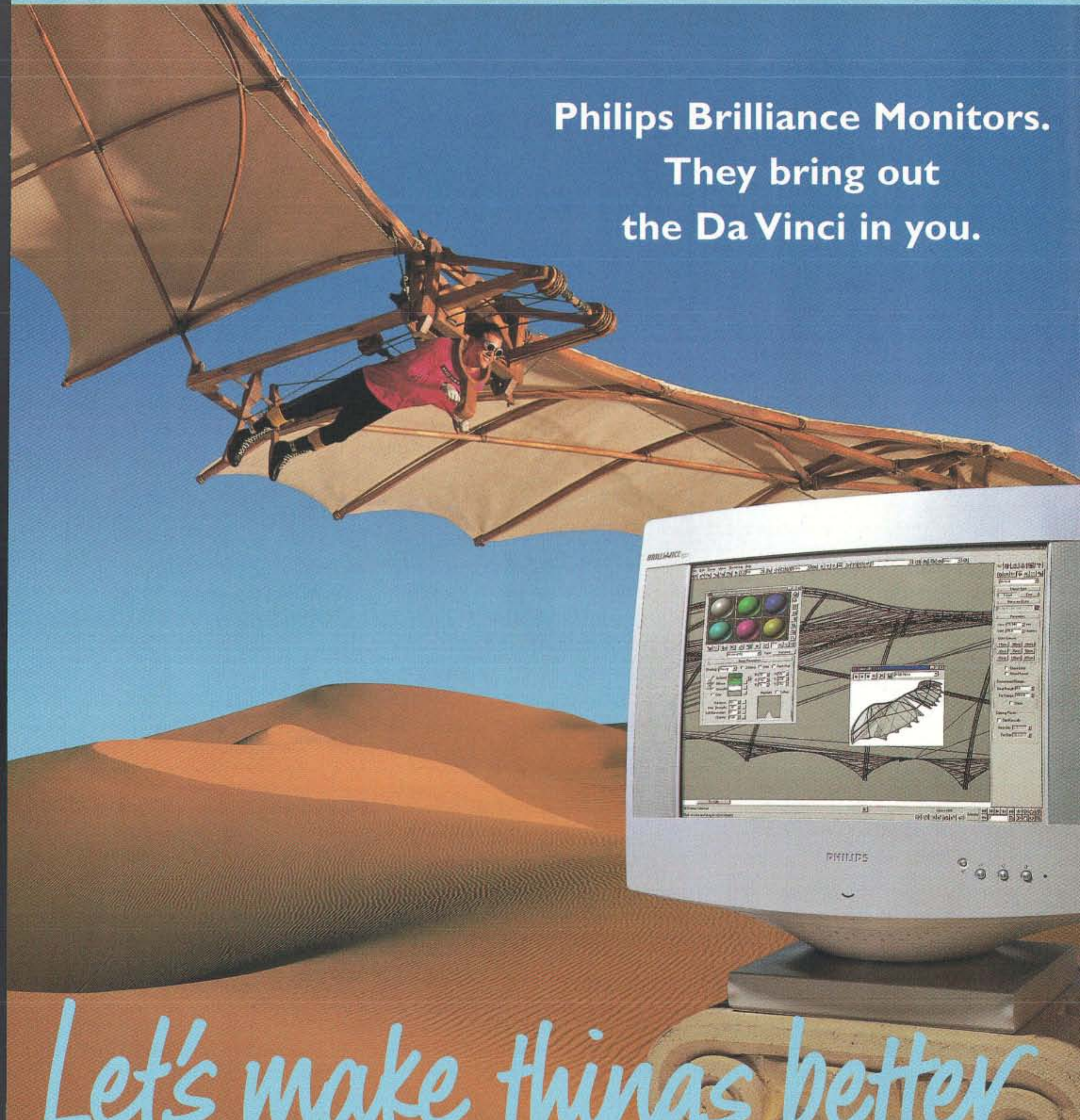
For more information about Java security, visit the Princeton Safe Internet Programming team's Java Security FAQ at **http://www.cs.princeton.edu/sip/java-faq.html** and the authors' Web site at **http://www.rstcorp.com/java-security.html.**

Applets vs. Applications

	Read/write local storage	Access any URL	Call native code	Code signing
Applets (JDK 1.02)	No	No	No	No
Applets (JDK 1.1)	Optional*	Optional	Optional	Yes
Applets (future JDK)	Selectable**	Selectable**	Selectable**	Yes
Applications (JDK 1.02)	Yes	Yes	Yes	No
Applications (JDK 1.1)	Yes	Yes	Yes	No
Applications (future JDK)	Selectable**	Selectable**	Selectable**	Yes

*Browsers can offer users the option of relaxing security restrictions based on whether or not an applet carries the authenticated signature of its creator, and whether the creator is trusted.

**Applets and applications can offer users more versatile options based on signing, the code's point of origin, or the type of action the code is attempting to do.



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5. A developer may not want to change, even if it costs money and customers.

It's important that most of the reasons are technical, subject to technological progress—and technological roadblocks.

Take the first reason. To a great extent, you can measure Java's maturity by its ability to take advantage of platform-specific features. Today, Java is definitely immature. It can access native features in two ways. The most desirable way is to encapsulate the native service in a Java class file, because it preserves cross-platform compatibility (assuming other platforms offer a similar service). The other way is to access the native features by calling their native code directly; this sacrifices cross-platform compatibility.

For example, Java has a class called `Button` that displays a push button on-screen. Push buttons are common to all GUIs. When a Java program instantiates a `Button` object, Java creates an intermediate peer object that maps the button to a corresponding routine in the native OS's API.

On a Windows PC, Java calls the button routine in the Win16 or Win32 API. On a Mac, Java calls the button routine in the Toolbox. On a Unix system, Java might call the button routine in Motif. This abstraction gives you a Java button that looks like a native button on screen, even when you run the same class file on different systems.

Java's Abstract Windowing Toolkit (AWT) is a standard class library that encapsulates a large number of these basic GUI components. Additional libraries encapsulate other native services. But they don't include them all. There's no support in the current JDK (1.02) for drag-and-drop editing, the playback of QuickTime movies, and numerous other advanced services.

New class libraries will address many of these shortcomings. JDK 1.1 will include a more complete AWT, and JavaSoft is working on a slew of libraries to fill in the remaining gaps. Also coming this year are classes to support richer multimedia (including 3-D graphics and audio/video playback), more flexible security, on-line commerce, telephony, network management, enterprise interoperability, cross-platform components, and server-side Java processes (called *servlets*).

JavaSoft is releasing these libraries in stages, preceded by specs that introduce programmers to the new classes and methods. For instance, some of the enterprise classes are available now, letting Java programs access corporate databases through Java Database Connectivity (JDBC) interfaces. There are also gateways to Common Object Request Broker Architecture (CORBA) components and remote method invocations (RMIs).

Who's Using Java

COREL OFFICE FOR JAVA

Corel is developing the first suite of general-purpose business applications in Java, including a WordPerfect-based word processor, a Quattro Pro–based spreadsheet, and other components. To overcome early problems with Java, Corel developed its own foundation classes and a memory management mechanism that dynamically loads and unloads class files as needed.

ANYWARE (APPLIX)

The Anyware family of products uses Java to deliver business applications to networked desktops. The Anyware WebSheet can export the data in Microsoft Excel and Lotus 1-2-3 formats.

NETRESULTS (INNOTECH MULTIMEDIA)

NetResults is a suite of tools for Web sites and intranets. It includes a new multithreaded search engine that performs multiple concurrent searches across heterogeneous networks, with results in order of relevance.

ORBIXWEB 2.0 (IONA TECHNOLOGIES)

OrbixWeb lets Java applets work with distributed Common Object Request Broker Architecture (CORBA) objects, opening an important gateway to remote client/server applications.

LAYOUT MILL (IGNITE TECHNOLOGIES)

Layout Mill is a new Java development tool written entirely in Java, so developers can run it on any platform and write for any platform. A GUI "switch" lets programmers preview their program's look on Windows PCs, Macs, and Unix/Motif systems just by clicking on a button.

Sun and JavaSoft aren't working on this alone. Java has broad industry support. Examples include Symantec's dbAnywhere, which provides the middleware and Open Database Connectivity (ODBC) drivers to connect Java programs to Oracle, Sybase SQL Server, Microsoft SQL Server, Microsoft Access, and numerous other databases. Centura Software (formerly Gupta) sells Centura Web Developer, which lets corporations build Java programs that simultaneously connect to multiple databases via IBM's Customer Information Control System (CICS), a transaction-processing monitor.

Corporate developers who need to make Java applications fit with legacy code are encountering fewer roadblocks. However, if a developer absolutely needs a native service that Java doesn't support, Java has a method modifier (`native`) that lets a Java application directly call a native executable file, such as a DLL or an OS API. This also delivers native performance.

Unfortunately, native methods have two major drawbacks. Java applets (programs that run in a Web browser) currently are not allowed to call native methods, for obvious security reasons. Sun is developing a new security model that will let users and administrators selectively change this restriction, as well as other security rules. More seriously, native methods undercut Java's cross-platform compatibility. A Java program that relies on native methods would need a similar method on every supported platform.

Sun's new component architecture, JavaBeans, will accelerate Java's encapsulation of native features by bringing more third-party developers into the fray. Beans are easier to write than Microsoft's ActiveX objects or Component Integration Laboratories' OpenDoc Live Objects, yet they can interact with those component architectures (see the text box "JavaBeans: Cross-Platform Components" on page 74).

Speed Limits

Developers who need maximum performance have a good reason for avoiding Java: They can write a compiled program in C or C++ that runs at least 10 times faster than an interpreted Java program. For many applications, this isn't important. Tools such as Visual Basic and PowerBuilder are popular because they're fast enough. But when performance does matter, there's no denying that interpreted Java byte code is slow.

To some degree, this problem will solve itself as computers get faster. Of course, native code will run faster on those new computers, too, so this won't eliminate the performance gap. However, the gap does not have to close altogether for Java to suc-

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ceed. Compiled C/C++ code doesn't run as fast as expertly written code in assembly language, yet few developers are using assembly language these days for anything but optimizing critical routines. C/C++ rules because it's more portable and it helps programmers work more productively—the same advantages that Java offers over C/C++.

Nevertheless, programmers and toolmakers are striving to improve Java's performance. Programmers can write inline code (see "Better Java Programming," September 1996 BYTE). Sun Microelectronics and International Meta Systems are designing microprocessors that will execute Java byte code directly.

Perhaps the most promising solution is just-in-time (JIT) compilers. Like Java interpreters, they convert byte code into native code on the fly, but they cache the converted code in memory while the program runs.

JIT compilers can be completely transparent to users. Java programs that run through a JIT compiler can achieve up to 50 percent of the speed of native code, and the technology is steadily improving. Netscape plans to bundle a JIT compiler with Navigator 4.0, and Microsoft, IBM, and Apple plan to integrate JIT compilers with their Java run-time environments.

Another option is static compilation. Silicon Graphics Inc. (SGI) technology translates byte code into Mips Rx000 native code, links the resulting binaries to the Java class files, and adds a second entry point to the Java method block. Java programs, running on SGI's specially modified VM, check the method block to see if there's a pointer to a translated method. If so, the program executes the translated method instead of the byte code version. Combined with inline coding, this allows Java to approach the performance of C++, according to David Henke, engineering manager of SGI's Web Products Division.

As with native methods, however, SGI's technology limits cross-platform compatibility—the translated code runs only on a Mips CPU. It offers two advantages. Developers can easily separate the translated code from the byte code to regain portability, and programmers can write an entire project in Java instead of writing native methods in another language.

There's no reason why SGI or someone else couldn't adapt this technology to other CPU architectures. Java applets will probably always exist as platform-neutral byte code, because they're embedded in Web pages that must run on any browser. However, stand-alone Java applications that need top performance will almost certainly rely on some kind of JIT or static compiler. The performance boost is significant, and it doesn't have to interfere with the cross-platform compatibility that is Java's greatest strength.

Higher Abstraction

In the long run, none of the technical problems that might deter today's developers are likely to pose an insurmountable obstacle for Java. As both a language and a platform, Java is evolving at an unprecedented pace. We can speculate on Java's course because it's consistent with historical trends in computing.

The most important trend is toward higher levels of software abstraction above the hardware. The more tightly that software is intertwined with hardware, the bigger the headaches for developers and users. Programmers get more performance by writing to the metal, but the code is hard to maintain and even harder to port. And code lives longer than anyone plans.

That's why the computer industry is spending billions of dollars rewriting ancient code that can't handle the year 2000. That's why the U.S. air-traffic-control system is still running on antiquated machinery from the 1960s. That's why the Social Security Administration is patching a program from the 1970s that has been underpaying retirees for two decades. Put bluntly, it's negligent for software developers to ignore the possibility that their code may live for 10 or 20 years.

Java carries software abstraction to the next level because it abstracts everything below the VM. It's designed for a world in which the OS and CPU are interchangeable parts that can be replaced without breaking applications. It's designed for an age of diversity in which PCs and other smart devices can use any CPU or OS that delivers the best performance, the lowest cost, the most efficient power consumption, the lightest weight, or any other parameter that becomes important. Java's success isn't inextricably tied to network computers, PDAs, and smart appliances, but Java is ideal for devices that expand today's narrow definition of a PC.

Unix and NT offer some hardware abstraction, but they're multiplatform, not cross-platform. Users still have to replace or recompile all their software if they switch CPUs, and not all software is available for all CPUs. Also, these OSes still chain you to an OS. Java can run on just about any OS or CPU.

Java Resources

Gamelan
(http://www.gamelan.com/index.shtml)

This on-line directory can point you to thousands of Java applets and applications, Java development tools, and links to hundreds of other Java-related Web sites.

Gambling on Java

So a developer's decision about adopting Java depends on three questions. First, can Java handle the job? It should be clear by now that Java is suitable for a wide range of applications and is gaining ground fast. Still, it can't do everything, and the tools need to get a lot better.

Second, does cross-platform compatibility matter? If you believe the computers of tomorrow will be basically the same as the computers of today, only with more megabytes and megahertz, Java isn't the best choice. Other languages and tools are more refined and deliver better performance on traditional hardware.

If, however, you'd like to write code that runs on any hardware, the final question is whether Java is the best cross-platform option. The answer depends on the maturity of Java, which changes almost daily. Certainly you can do a lot with Hypertext Markup Language (HTML), JavaScript, VB Script, Perl, and other cross-platform solutions, especially if Microsoft delivers on its promises for ActiveX.

But it's hard to bet wrong on Java. History shows that those who gamble correctly on an emerging platform win big, and those who gamble wrong end up with dead code. Even if Java fails to conquer the world as a platform, you'll still end up with code that runs on whatever platform rules the kingdom. For developers, the risks are minimal. For users, Java could bring a new freedom to change OSes and CPUs without breaking software—a freedom they've never had before.

Tom R. Halfhill is a BYTE senior editor based in San Mateo, California. You can reach him on the Internet at **thalfhill@bix.com.**

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In the last 10 years, two factors have combined to help data warehouses proliferate. First, we've recognized the benefits of on-line analytical processing (OLAP) beyond the traditional areas of marketing and finance. Organizations now find that the insights buried in the masses of data they routinely collect on their customers, products, operations, and business activities contribute to cutting operating costs and increasing revenues, not to mention making it easier to arrive at strategic decisions.

Second, the growth of client/server computing has spawned server hardware and software that's more powerful and more sophisticated than ever. Today's servers now rival yesterday's mainframes and offer technologically superior memory architectures, high-speed processors, and massive storage capacities. At the same time, modern DBMSes provide more support for complex data structures and promote standardized middleware. From this hardware/software renaissance emerges the multiterabyte data warehouses we're now seeing in client/server environments.

How do you take advantage of these technology advances? In the following pages, we'll describe how to choose the right warehouse for your enterprise. "Warehouse Cornerstones" explains the pros and cons of centralized and multitiered warehouse architectures and gives advice on how to choose the right servers and DBMSes. "Better Clients, Better Decisions" will help you match the right analysis tool to the cross-section of people who will be using your data warehouse. And "Take Your Data to the Cleaners" discusses the choices you have among home-grown and commercial programs that filter out nagging inaccuracies and inconsistencies in your information.

A data warehouse consists of myriad pieces. If you choose them wisely, you could end up with a repository of invaluable data to inform your strategic decision making. In all likelihood, there is gold buried in the data dispersed across your enterprise. You only need to find it.

– Jay-Louise Weldon and Alan Joch

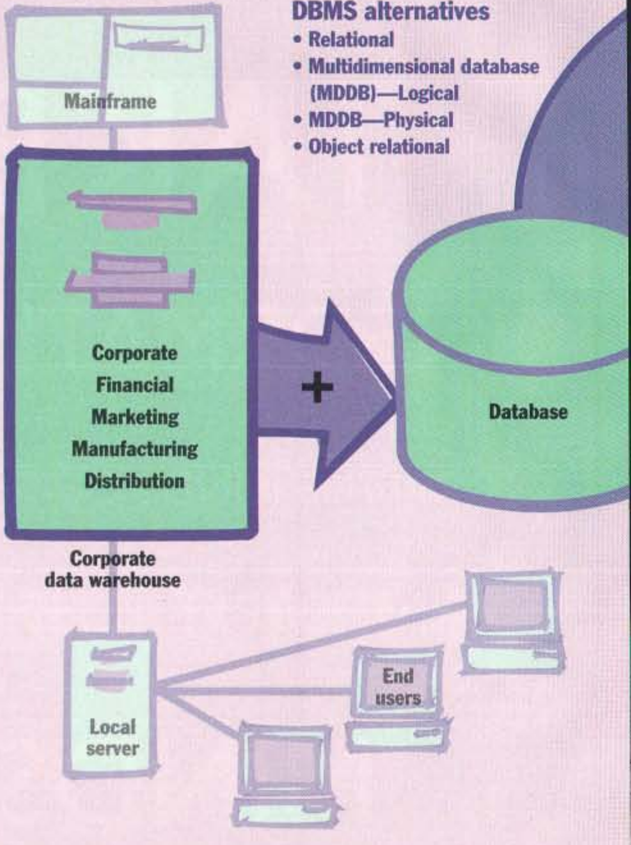
Like a physical warehouse built from bricks and mortar, a data warehouse begins with your choice of an overall architecture. This decision will influence the other essential components you select.

1 **For example, if you need fast performance and the ability to analyze multidimensional data (i.e., sales for a given product by year, by region, by store), you might pair a central-server architecture...**

Architecture alternatives
- Federated
- Tiered

2 **...with a "super-relational" DBMS that provides specialized indexing schemes to pre-join tables.**

DBMS alternatives
- Relational
- Multidimensional database (MDDB)—Logical
- MDDB—Physical
- Object relational



Warehouse Cornerstones . . . 85

A successful data warehouse starts when you choose and integrate three key elements.

Better Clients, Better Decisions . . . 91

Without proper end-user tools for data access and analysis, a warehouse may be shuttered.

By clicking on a category, you can expand the entry to see greater levels of detail.

Sales
Year to date ($millions)

Electronics	Q1	Q2	Q3	Q4
VCR	$1.4			
Camcorder	$0.6			
TV	$2.0			
CD Player	$1.2			

+

Products	Q1	Q2	Q3	Q4
Electronics	$5.2			
Toys	$1.9			
Clothing	$2.3			

3 Next, you'll add on-line analytical processing (OLAP) tools that let end users pivot, drill down, and perform other "slicing and dicing" operations to analyze the data.

Business intelligence tool alternatives

- Querying and reporting programs
- Executive information systems
- Data mining applications

+

Take Your Data to the Cleaners . . . 97

"Dirty" data is dangerous. Custom scripts and specialized cleansing tools provide safety nets.

Customer ID#	Name	ZIP	Sales
4462	RS Inc.	03458	$4562
3458	Robert Smith Inc.	03458	$6236
8520	Smith, Robert	03458	$1250

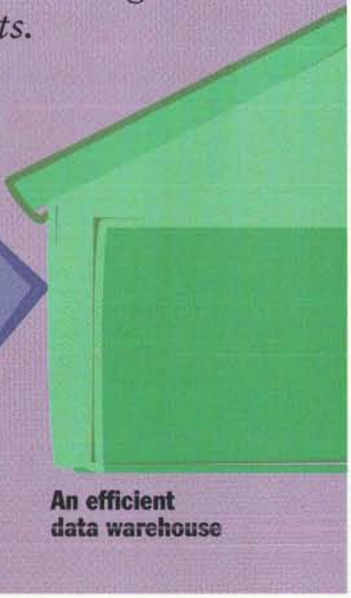
Customer ID#	Name	ZIP	Sales
3458	Robert Smith Inc.	03458	$12,048

=

4 Responsiveness and flexibility are useless if you're analyzing incorrect or misleading data. A high-end data-cleansing program, with scripts that impose your understanding of your business onto the data, provides the finishing touch.

Data-cleansing alternatives

- Custom "scrubbing" scripts
- Data validation tools
- Cleaning, transformation, synchronization software



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Security	9.3	6.3
Ease of Learning	9.1	7.1
Ease of Use	8.3	7.2
Versatility/Features	10	8.7
Compatibility	6.7	6.5
Speed of API Calls	0.9	1.2
Final Score	**8.5**	6.5

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Circle 129 on Inquiry Card (RESELLERS: 130)

Successful data warehouses start when you choose and successfully integrate three key elements. *By Jay-Louise Weldon*

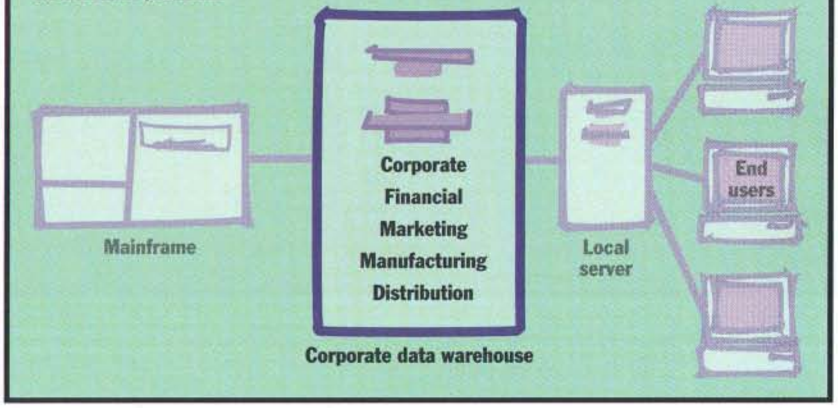
Warehouse Cornerstones

Assembling the bricks and mortar of a conventional warehouse looks easy compared to integrating the server hardware and DBMSes that frame a data warehouse. On the hardware side, you must mix and match server platforms and configurations while deciding how to take advantage of almost-constant leaps in raw processing power. On the software side, the complexity and high cost of DBMSes force you to make tough decisions and inevitable trade-offs with regard to integration issues, support requirements, performance, efficiency, and reliability.

What if you choose incorrectly? Your data warehouse becomes an enterprise-wide problem that is difficult to work around, expensive to fix, and hard to justify. To get your warehouse implementation off to a successful start, you need to focus on three key building blocks: the overall warehouse architecture, the server architectures, and DBMSes. Here are some guidelines for making the right choices for your enterprise.

Warehouse Foundation

In a centralized architecture, a single, integrated data warehouse reflects all aspects of the business. Separate subject databases are all interrelated and are physically stored on the same platform.



A centralized data-warehouse architecture provides efficiencies in both processing power and support costs.

The Blueprint

Data-warehouse development begins with the logical and physical structure of the warehouse database plus the services required to operate and maintain it. This choice drives the selection of the other two fundamental items: the server hardware and the DBMS.

The physical platform can be centralized in one location or distributed regionally, nationally, or internationally. One scheme for housing your company's data, which might be gathered from multiple internal and external sources, is to consolidate the database in one integrated data warehouse (see the figure "Warehouse Foundation" above). The consolidated approach helps to maximize your available processing power. A second approach, the federated architecture, distributes information by function, with financial data on a server at one site, marketing data at another location, and manufacturing data at a third venue (see the figure "Two Alternatives to a Centralized Architecture" on page 86).

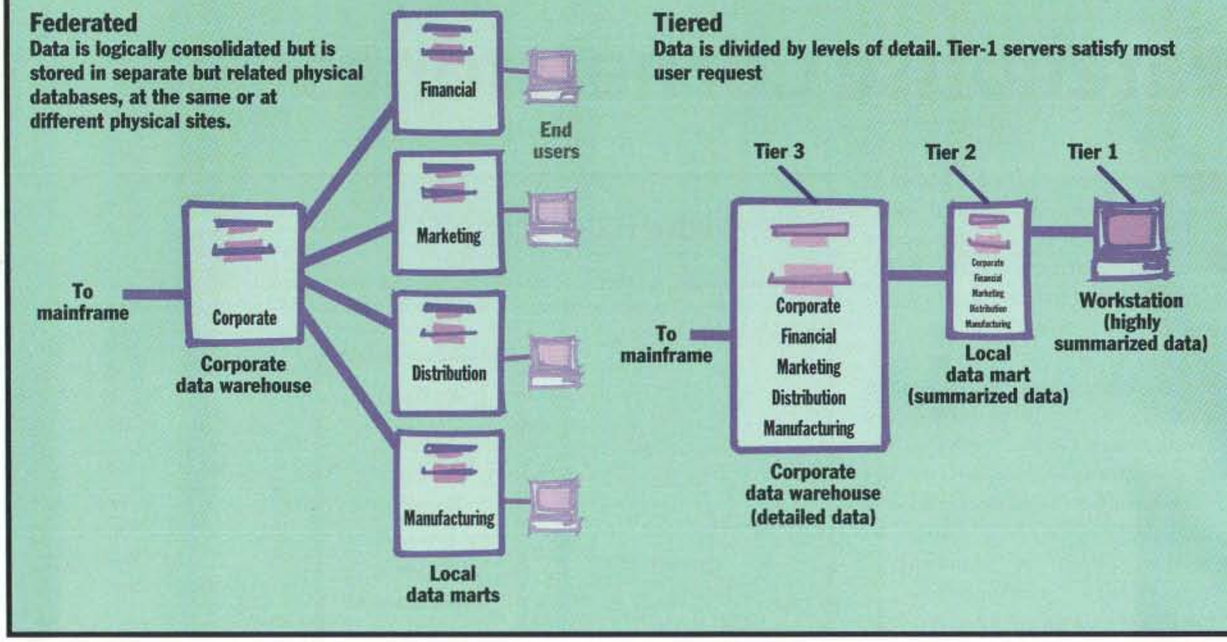
The third approach, a tiered architecture, houses highly summarized data on one user's workstation, with more-detailed summaries on a second server, and the most detailed information on a third. The first-tier workstation handles most requests for data, with successively fewer requests passing on to tiers 2 and 3 for resolution. Computers at the first tier can be optimized for heavy user loads and low data volume, while servers at the other tiers are more adept at processing heavy data volumes but lighter user loads.

As you're deciding on a centralized or distributed warehouse structure, you also need to consider the servers that will hold and deliver the data. The size of your implementation—and your enterprise's needs for scalability, availability, and systems management—all influence your choice of server architecture (see the figure "Server Architectures" on page 86).

Single-processor servers are the easiest to manage, but they offer limited processing power and scalability. In addition, a single server presents a single point of failure, limiting the guaranteed availability of the warehouse. You can expand single-server networks via distributed architectures that make use of middleware, such as Distributed Computing Environment (DCE) or Common Object Request Broker Architecture (CORBA), to distribute traffic across multiple servers. These architectures increase availability as well, since operations can be shifted to a backup server if one server fails, but systems management is more complex.

Symmetric multiprocessing (SMP) machines increase throughput by adding processors that share the server's internal memory and disk-storage devices. You can buy most SMP in minimal configurations (i.e., with two processors) and upgrade when necessary to handle growth in your processing needs. The scalability of an SMP machine reaches its limit at the maximum number of processors supported by the connection mechanisms

Two Alternatives to a Centralized Architecture



Federated

Data is logically consolidated but is stored in separate but related physical databases, at the same or at different physical sites.

Tiered

Data is divided by levels of detail. Tier-1 servers satisfy most user request

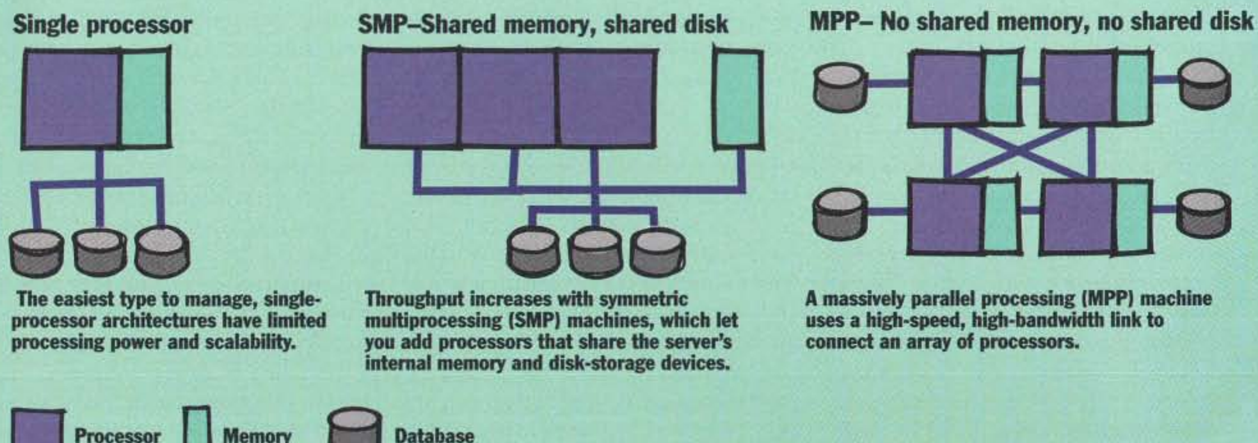
(i.e., the backplane and the shared bus).

A massively parallel processing (MPP) machine connects an array of processors via a high-speed, high-bandwidth link. Each node is a server, complete with its own (possibly SMP) processor and internal memory. To optimize an MPP architecture, applications must be "parallelized" (i.e., designed to operate in separate, parallel pieces).

This architecture is ideal for searching large databases. However, the DBMS that you select must be one that offers a parallel version. And even then, substantial design and tuning are required to achieve optimum data distribution and to prevent hot spots or *data skew* (where a disproportionate amount of the processing is shifted to one processing node due to the partition of data under its control).

The difficulty of moving applications and DBMSes to clustered or truly parallel environments has led to newer architectures, such as nonuniform memory access (NUMA). NUMA creates a single, large SMP machine by connecting multiple SMP nodes into a single (though physically distributed) memory pool and a single instance of the OS. NUMA allows the SMP approach to achieve the performance benefits of large MPP machines (with 32 or more processors) while maintaining the simplicity and management advantages of a standard SMP environment. Most appealing of all, existing DBMSes and applications can be moved

Server Architectures



Single processor

The easiest type to manage, single-processor architectures have limited processing power and scalability.

SMP–Shared memory, shared disk

Throughput increases with symmetric multiprocessing (SMP) machines, which let you add processors that share the server's internal memory and disk-storage devices.

MPP– No shared memory, no shared disk

A massively parallel processing (MPP) machine uses a high-speed, high-bandwidth link to connect an array of processors.

How DBMSes Compare

Feature/Function	Relational	Super-Relational	Multidimensional (logical)	Multidimensional (physical)	Object-Relational
Normalized structures	✓	✓			✓
Abstract data types					✓
Parallelism	✓				
Multidimensional structures		✓	✓	✓	
Drill-down			✓	✓	✓
Rotation			✓	✓	✓
Data-dependent operations					✓

✓ = yes

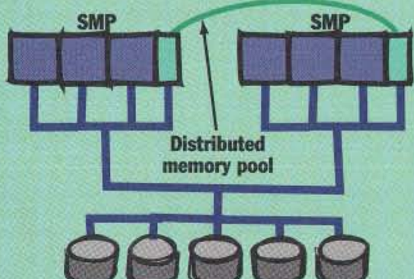
from single-processor or SMP platforms to NUMA with no modifications.

DBMS Decisions

Data warehouses (along with decision-support systems [DSSes] and client/server applications) were the first successes for the relational DBMS (RDBMS). While most operational systems were legacy applications mired in old data structures, warehouses and DSSes capitalized on RDBMS for their flexibility and ability to perform ad hoc queries.

RDBMSes are most flexible when they are used with a normalized data structure. In a normalized database, data structures are nonredundant and represent the basic entities and relationships described by the data (e.g., products, markets, and sales transactions). But a typical on-line analytical processing (OLAP) query that crosses several structures ("How many blue widgets did we sell in stores in the Midwest?") requires several join operations to put such data back together. The performance of traditional RDBMSes is better for key-based queries ("Find customer account #1234") than for content-based queries ("Find all customers with income over $50,000 who have bought an automobile in the last six months").

NUMA–Shared memory pool; single instance of OS



Nonuniform memory access (NUMA) machines join multiple SMP nodes into a single, distributed memory pool.

To support large-scale warehouses and improve responsiveness for OLAP applications, vendors have added new features to the traditional RDBMS. These so-called super-relational features include support for specialized database hardware, such as the Teradata database machine. Super-relational features also support extensions to storage formats and relational operations (offered by vendors such as RedBrick) and specialized indexing schemes, such as those used by Sybase IQ. These techniques can improve performance for content-based retrievals by pre-joining tables using indexes or through the use of fully inverted index lists.

Most data-warehouse-access tools exploit the multidimensional nature of warehouse data. For example, marketing analysts need to look at sales volumes by product, by market, by time period, by promotions and advertising levels, and by combinations of these different aspects. Structuring data in a traditional relational database to facilitate queries and analyses along different dimensions (e.g., star or snowflake schemata) has become commonplace. These schemata might use multiple tables and pointers to simulate a multidimensional structure. Some DBMS products, such as Essbase and Gentium, implement storage techniques and operators that support multidimensional data structures.

While multidimensional databases (MDDBs) help you directly manipulate multidimensional data objects (e.g., the easy rotation of data to view along different dimensions, or drill-down operations that successively expose more detailed levels of data), you must identify these dimensions when building the database structure. Thus, adding a new dimension, or changing the views desired, can be cumbersome and costly. Some MDDBs require a complete reload of the database when restructuring occurs.

New Dimensions

A limitation of both RDBMS and MDDB is a lack of support for nontraditional data types, such as images, documents, and video/audio clips. If you need these types of objects in your data warehouse, look to an object-relational DBMS, such as Informix's Illustra. Focused on coded data values, most database systems can accommodate these data types only with somewhat-awkward reference-based extensions, such as pointers to files containing the objects. Many RDBMSes store complex data as binary large objects (BLObs). In this format, the objects cannot be indexed, sorted, or searched by the server.

Object-relational DBMSes, on the other hand, store complex data as native objects and can support the extensive data structures found in an object-oriented environment. These database systems naturally accommodate not only special data types but also the processing methods that are unique to each (e.g., a COMPARE operation on a picture might return another picture with similar features).

But a disadvantage to the object-relational approach is that the encapsulation of data within special data types—a series of stock prices over time in each row of a stock table, for example—requires specialized operators for what were previously simple searches (e.g., "Find all stocks that showed a decline in price from April to May 1996").

DBMS selection is also tied to the server hardware you use. Some RDBMSes, such as DB2 Parallel, Informix XPS, and

Data-Warehouse Decision Matrix

For these environments...			Choose...		
Business requirements	**User population**	**Systems support**	**Architecture**	**Server**	**DBMS**
Scope: departmental **Uses:** data analysis	Small; single location	Minimal local; average central	Consolidated; turnkey package	Single-processor or SMP	MDDB
Scope: departmental **Uses:** analysis plus informational	Large; analysts at single location; informational users dispersed	Minimal local; average central	Tiered; detail at central; summary at local	Clustered SMP for central; SP or SMP for local	RDBMS for central; MDDB for local
Scope: enterprise **Uses:** analysis plus informational	Large; geographically dispersed	Strong central	Centralized	Clustered SMP	Object-relational; Web support
Scope: departmental **Uses:** exploratory	Small; few sites	Strong central	Centralized	MPP	RDBMS with parallel support

Oracle Parallel, offer versions that support parallel operations. Parallel software splits queries, joins across multiple processors, and runs these operations simultaneously to improve performance.

Parallelism is required for the best performance on large MPP and clustered SMP servers. It's not yet an option with MDDBs or object-relational DBMSes.

The table "How DBMSes Compare" on page 87 summarizes the pros and cons of the different types of DBMSes for warehouse operations. The table "Data-Warehouse Decision Matrix" above contains some examples of how these decision criteria affect the choice of a server/data-warehouse architecture.

Piecing It Together

To select the right combination of server architecture and DBMS, you first need to understand your company's business requirements, its user population, and the skills of the support staff.

Data-warehouse implementations vary considerably in scope. Some are designed to support specific analysis needs for a single department or functional area of an organization, such as finance, sales, or marketing. Other implementations bring together data from across the entire enterprise to support a variety of user groups and functions. As a general rule, the broader the scope of the warehouse, the more power and functionality required of the server and DBMS.

Warehouse-usage patterns are also a factor. Prestructured queries and report views often satisfy informational users while exacting fewer demands on the DBMS and the processing power of the server. Complex analysis, which is typical of decision-support environments, requires more power and flexibility from all server components. Massive searches of large data warehouses favor parallelism in both DBMS and server.

Dynamic environments, with their ever-changing requirements, are served best by a simple, easily changeable data architecture (e.g., a highly normalized relational structure) rather than an intricate structure that requires rebuilding after every change (e.g., a multidimensional structure). The required data-refresh rate indicates how responsive the data warehouse must be to new and changing data. Large data volumes that are refreshed at frequent intervals favor a physically centralized architecture to support efficient data capture and minimize data-transport time.

A user profile should identify who your data warehouse's users are, where they're located, and how many you need to support. Information about how each group expects to use warehouse data will help you analyze the various usage styles.

Knowing the physical location of your users helps you determine how and to what extent you need to distribute warehouse data. A tiered architecture might use servers already in place on LANs. Or you may need a centralized approach to support mobile workers who tap into the warehouse from their laptops.

The total number of users and their connection patterns determine the size of your warehouse servers. Memory sizes and I/O throughput must support the anticipated number of concurrent users under normal conditions as well as at peak usage times at your organization.

Finally, you must factor in support-staff sophistication. The IS resources that are available within your organization might limit the complexity or sophistication of your server architecture. Without skilled in-house staff or outside consultants, an architecture that requires server-platform parallelism (MPP or clustered SMP, for example) is difficult to create and maintain successfully.

Expansion Plans

As your warehouse matures and the data it contains becomes more accessible, employees outside the warehouse might also discover the value of its data. By linking your data warehouse to other systems—both internal and external to the organization—you can share information with other business entities with little or no custom development. E-mail messages, Web servers, and intranet/Internet connections can deliver inventory levels to your suppliers or order status to your business partners.

As data warehouses continue to grow in sophistication and usability, the data accumulated within an enterprise will become more organized, more interconnected, more accessible, and more generally available to more employees. The result? Better business decisions, more business opportunities, and a more enlightened work force. **B**

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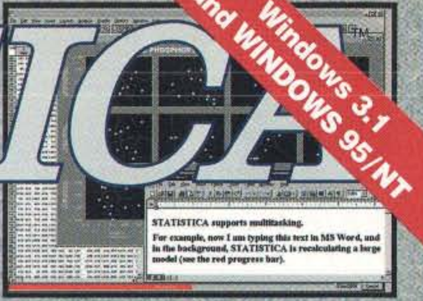

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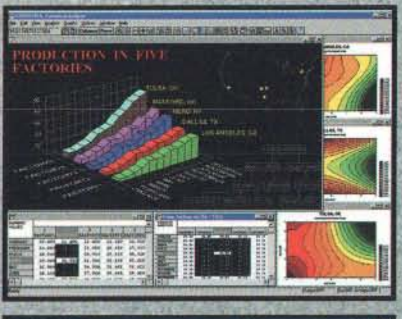

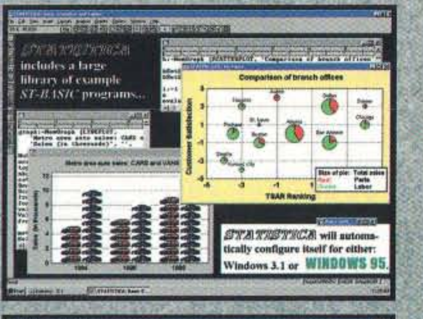

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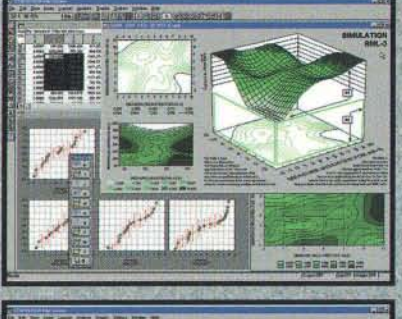
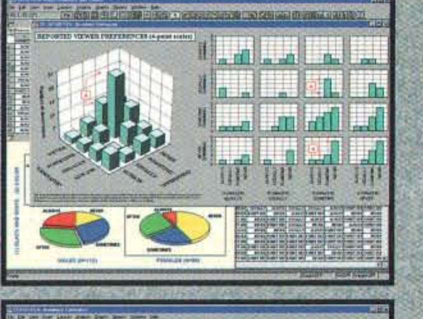
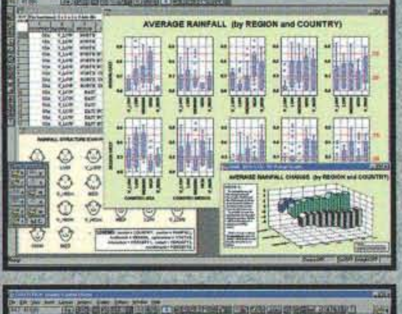
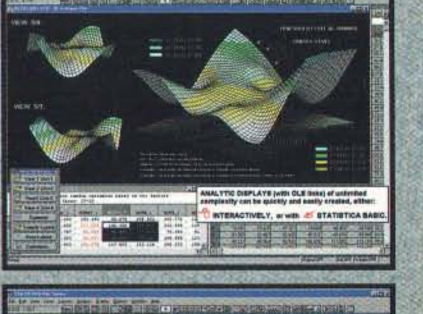
STATISTICA will automatically configure itself for either: Windows 3.1 or WINDOWS 95.

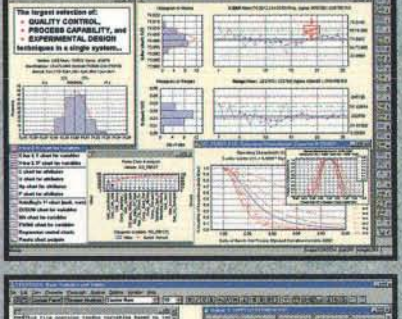





AVERAGE RAINFALL (by REGION and COUNTRY)
AVERAGE RAINFALL CHANGE (by REGION and COUNTRY)



ANALYTIC DISPLAYS (with OLE links) of unlimited complexity can be quickly and easily created, either: INTERACTIVELY, or with STATISTICA BASIC.



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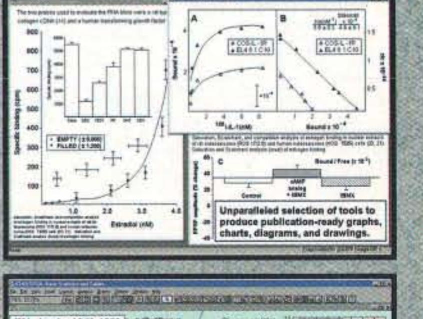

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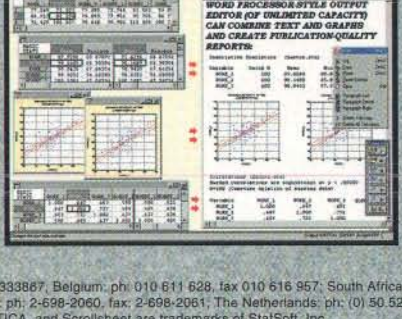
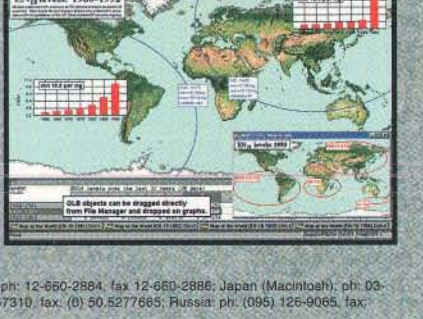


WORD PROCESSOR-STYLE OUTPUT EDITOR (OF UNLIMITED CAPACITY) CAN COMBINE TEXT AND GRAPHS AND CREATE PUBLICATION-QUALITY REPORTS:



OLE objects can be dragged directly from File Manager and dropped on graphs.

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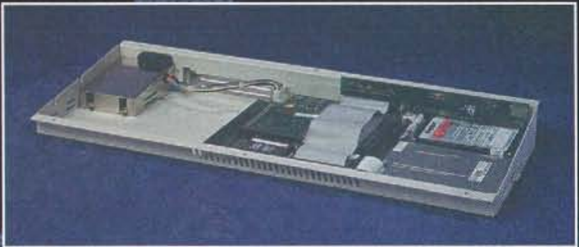

Primitive design chooses to house a tiny microprocessor inside a bulky case. With desk space being a rare commodity these days, why put up with such stone-age packaging? Cut the clutter with the Keyboard Network Station (KNS) from Advanced Interlink Corporation.

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State of the Art

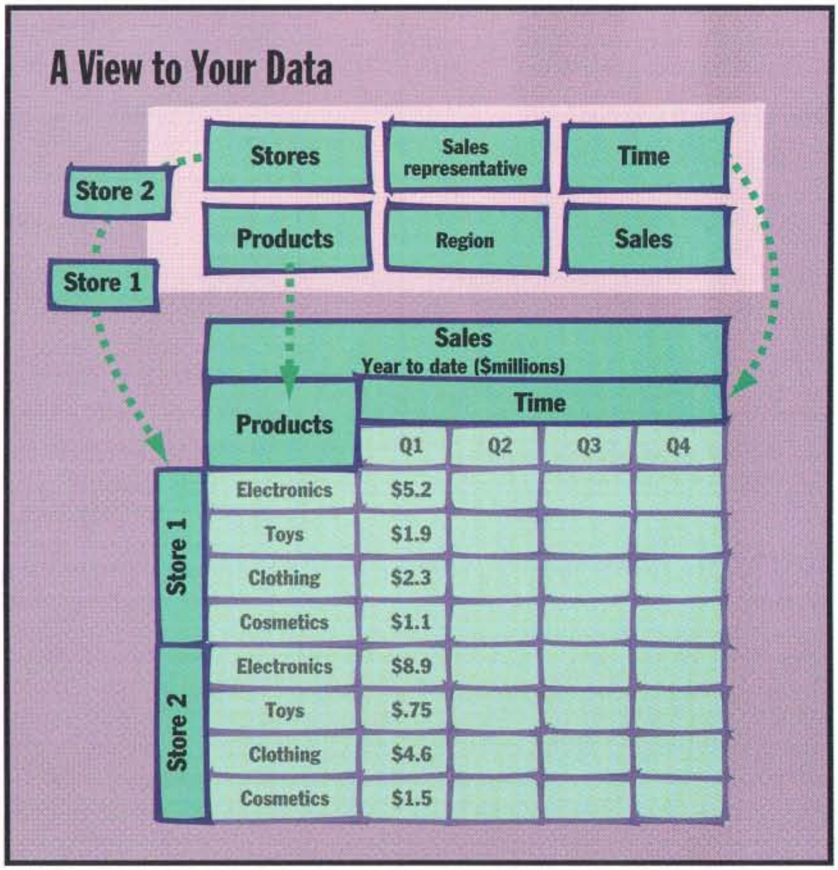
Without the proper end-user tools for data access and analysis, your data warehouse may be shuttered. *By Alan Simon*

Better Clients, Better Decisions

You know it's there. Buried in gigabytes of marketing data or point-of-sale transactions lies the key information about an important customer trend or a successful product launch. Now all you have to do is extract it in a way that informs the decision at hand.

You need a specialized tool that lets you capture the relevant data quickly and view it across many different data dimensions. The tool shouldn't stop at merely accessing data—it should also give you a way to meaningfully analyze the data; in effect, transforming raw data into useful business information.

Business intelligence tools sit on top of the data warehouse and provide this service. Because they're the main point of contact between your warehouse application and the people who use it, these tools also can be the difference between a warehouse's success or failure. Business intelligence tools have become the successor to decision support systems, but they have a broader scope: They not only support decision making but, in many cases, these tools support operational, mission-critical functions of the company, too. However, business intelligence products aren't foolproof: You get the most out of your data warehouse only as long as you match the right tool to the needs of each end user.



		Sales Year to date ($millions)			
	Products	Time			
		Q1	Q2	Q3	Q4
Store 1	Electronics	$5.2			
	Toys	$1.9			
	Clothing	$2.3			
	Cosmetics	$1.1			
Store 2	Electronics	$8.9			
	Toys	$.75			
	Clothing	$4.6			
	Cosmetics	$1.5			

OLAP tools let you drag relevant categories like "Stores" and "Products" to a blank grid to build custom views of your data.

Beyond Queries

The simplest of these tools are basic querying and reporting products. They provide graphical front ends to SQL generators (or, more accurately, database access-call generators). Rather than requiring you to learn SQL or write a program to access database information, the querying tool lets you point-and-click menus and buttons to specify data elements, conditions, grouping criteria, and other attributes of an information request (see the figure "A View to Your Data" above). The query tool then generates a database call, extracts the relevant data, performs additional calculation and data manipulation if necessary, and presents the results in a clear format.

You can store queries and report requests for subsequent submission, either as is or with modifications. Statistical processing is usually limited to averages, summations, standard deviations, and other basic analysis functions. Although the capabilities vary from one product to another, querying and reporting tools are most appropriate when you need an answer to the question "What happened?"—as in "How do last month's sales for products X, Y, and Z compare with the previous month's sales and the same month's sales last year?"

To make queries more accessible to nontechnical people, products like Seagate's Crystal Reports, Cognos' Impromptu, Borland's Reportsmith, IQ Software's Intelligent Query, Software AG's Esperant, and Andyne's GQL offer graphical interfaces for drag-and-drop selections. The more advanced of these products will steer you away from queries that have bad syntax or that return unintended results. Access to data has also improved with new versions of these products as vendors ship standard drivers such as ODBC and native 32-bit drivers to popular data sources.

continued

In general, data warehouse managers who are going to use these types of products should be prepared to spend time resolving setup tasks like managing directories and libraries, installing connectivity software, establishing English-like names, and precalculating "virtual data fields." Once you create your SQL front end, you may need to develop a set of standard queries and reports, although some products offer libraries of prebuilt templates and predefined reports that you can quickly modify.

On-Line Analysis

Report generators fall short when end users need more than a single, static view of data that is not subject to further manipulation. For these users, on-line analytical processing (OLAP) tools provide "slice and dice" capabilities that go beyond answering "what happened?" to analyzing why the results are the way they are (see "Two Ways to Slice and Dice Data" at right). The first OLAP solutions were based on multidimensional databases (MDDBs). A structural cube (dubbed a hypercube or a multidimensional array) stored the data so you could manipulate it intuitively and clearly see the associations across multiple dimensions. Pioneering products such as Arbor Software's Essbase directly support the various views and dimensional manipulations required by OLAP.

But the MDDB approach has two limitations. First, new data-storage structures require proprietary databases. There are no truly open standards for accessing multidimensional data. Vendors such as Arbor saw this as an opportunity to create de facto standards by publishing MDDB APIs, encouraging third-party tools, and establishing strategic partnerships. Many third-party query tools and data-mining solutions directly support Essbase, Oracle Express, and other popular MDDB formats. Commander OLAP, Comshare's client/server tool, sits on top of an Essbase multidimensional data store and supports dynamic access and manipulation of data.

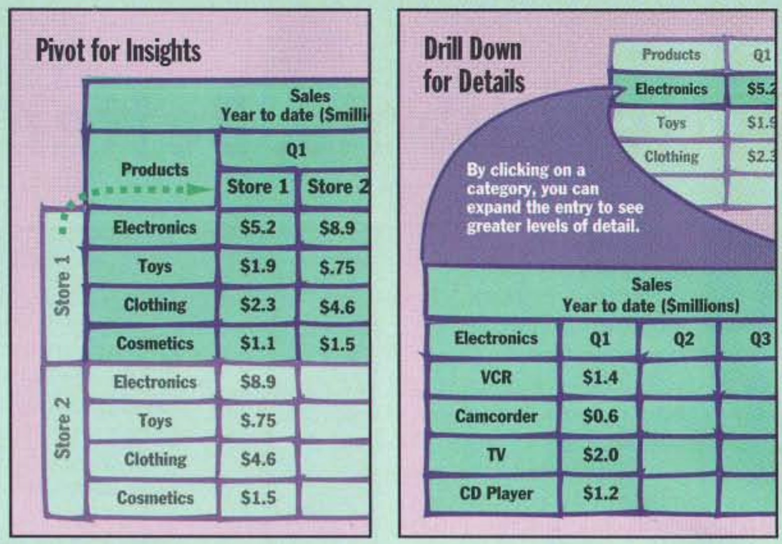
The second limitation of MDDB concerns populating the data structure. Companies typically store enterprise data in relational databases, which means that someone has to extract, format, and load this data into the hypercube. This process can be complex and time-consuming but, again, vendors are searching for solutions. Data pumps and other tools automate the process by mapping relational fields into the multidimensional structure and populating the MDDB on-the-fly.

Some vendors are now evangelizing relational OLAP (ROLAP), which taps into the data warehouse directly using standard SQL calls. The front-end tools let you submit multidimensional requests, but the ROLAP engine transforms the queries into SQL routines. You then receive cross-tabulated results as a multidimensional spreadsheet or in some other form that supports rotating, drilling down, and slicing.

Even with a data pump, developing and populating the MDDB structure can be challenging. ROLAP administrators must face the sometimes daunting task of developing the SQL routines to aggregate and index ROLAP data as well as to ensure correct translation of multidimensional requests into SQL command sets.

Advocates of ROLAP argue that it uses open standards (SQL) and that it makes atomic (detail-level) data more readily

Two Ways to Slice and Dice Data



Pivot for Insights

	Products	Sales Year to date ($milli	
		Q1	
		Store 1	Store 2
Store 1	Electronics	$5.2	$8.9
	Toys	$1.9	$.75
	Clothing	$2.3	$4.6
	Cosmetics	$1.1	$1.5
Store 2	Electronics	$8.9	
	Toys	$.75	
	Clothing	$4.6	
	Cosmetics	$1.5	

Drill Down for Details

Products	Q1
Electronics	$5.2
Toys	$1.
Clothing	$2.

By clicking on a category, you can expand the entry to see greater levels of detail.

	Sales Year to date ($millions)		
Electronics	Q1	Q2	Q3
VCR	$1.4		
Camcorder	$0.6		
TV	$2.0		
CD Player	$1.2		

Some tools pivot data: Here sales data moves side by side for easier comparison.

Drilling down presents increasingly detailed levels of data.

Choose the Right Tool

Tool Type	Basic Question	Sample Output	Typical User
Querying and reporting	"What happened?"	Monthly sales reports; inventory histories	Needs historical data; may have limited technical prowess
On-line analytical processing (OLAP)	"What happened, and why?"	Monthly sales vs. competitors' price changes	Needs to go from static views of data to "slicing and dicing"; technically astute
Executive information system (EIS)	"What do I need to know now?"	Briefing books; command centers	Needs high-level or summarized information; may not be technically astute
Data mining	"What's interesting?"; "What might happen?"	Predictive models	Needs to extract obscure data relationships and trends; technically astute

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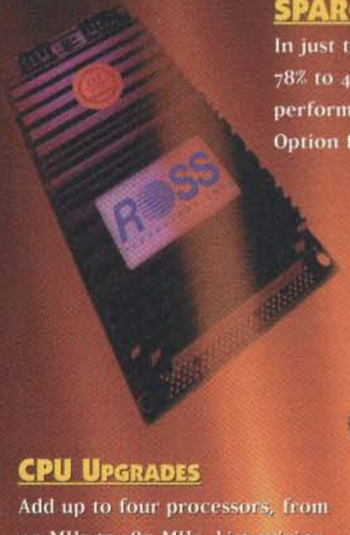

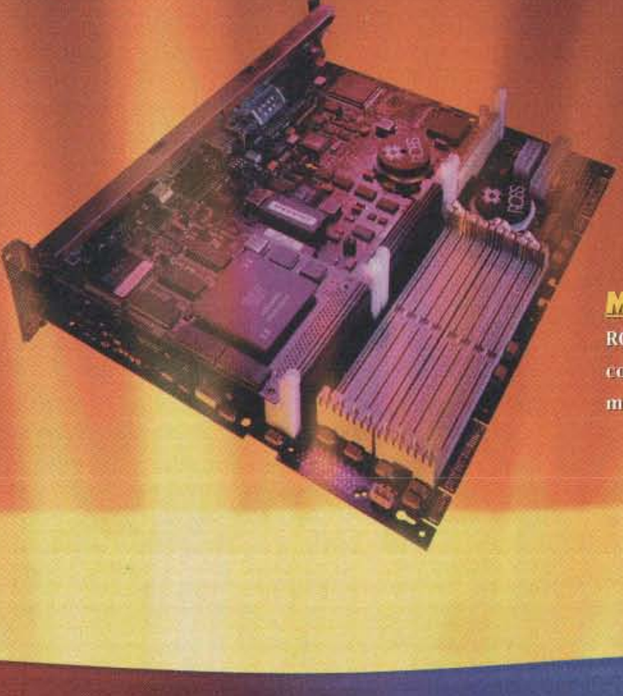

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AD__BYTE 0197

accessible. On the other hand, advocates of MDDB argue that a native multidimensional structure achieves better performance and flexibility once you populate the data store. The good news is that both of these technologies are maturing rapidly, and either can provide a strong OLAP solution. Some product examples are Cognos' PowerPlay, Business Objects' software of the same name, Brio Technology's BrioQuery, and MicroStrategy's DSS Agent/DSS Server suite.

The administrative and development challenges of OLAP, while similar to those encountered with query and reporting tools, are generally more complex. Setting up the OLAP and the data access software requires a clear understanding of the corporation's data models and the analytical functions required by executives, managers, and other data analysts. Commercial development products can ease the pain, but OLAP is rarely a turnkey solution; the architecture must be tuned to support your data sources and requirements. But once you've set up an OLAP system, ongoing end-user support is minimal.

For the Busy Executive

The concept of the executive information system (EIS) is simple: Executives have neither the time nor, in many cases, the expertise to perform OLAP analysis of large volumes of data. The EIS presents simplified, highly consolidated, and mostly static views of the data.

There are two major categories of EIS environments: the briefing book and the command center. The briefing book is an electronic, on-line version of its paper counterpart that many executives use in staff meetings. Electronic slides present a concise picture of an organizational initiative or perhaps data to reveal the current status of a major project.

The command center is basically a collection of ports into a wide array of reports, newsgroup retrievals from the Internet, and other materials that provide insight into the organization. Command-center reports may be accessed daily, or more often if information changes frequently, or only when exceptions warrant. Some products generate alarms when specified exceptions occur.

When appropriate, each briefing-book slide or command-center screen should permit the executive to receive additional information if desired (and if available). Unlike the OLAP model, where increasing levels of information are revealed as the analyst manipulates the data, an executive expects the overview up front. He or she should not have to dig for answers. Therefore, when the executive requests more information from briefing-book slides or command-center screens, the display should be carefully constructed to present primarily supplemental, amplifying information. The executive should be able to bypass every prompt for "more information" without missing any critical information.

Savvy executives may administer their own briefing book and command center, or administrators could maintain and modify the EIS according to the executive's specifications. EISes typically have a programming or scripting capability that will vary in complexity from one product to another. Pioneers in the EIS market include Comshare, makers of Commander EIS, and Pilot Software, developers of Pilot Command Center.

Digging for Data

Data mining is a category of open-ended analysis tools. Instead of asking them questions, you hand these tools reams of data and ask for something "interesting" in return—a trend or a peculiar grouping, for instance. The process of data mining extracts hidden knowledge or predictive information from the data warehouse without requiring specific questions or requests.

Mining tools use some of the most advanced computing techniques—neural networks, rule discovery, deviation detection, predictive modeling, and genetic programming—to derive patterns and associations. Mining is a data-driven, rather than an application-driven, approach.

IBM's Intelligent Miner for AIX supports sophisticated mining techniques as well as data preparation functions to extract information from Oracle or Sybase databases and load it into DB2 for mining. With its Data Mine option for the Red Brick Warehouse 5.0 engine, Red Brick integrates data mining functionality and a warehousing architecture. Other examples of commercial data mining tools include Darwin from Thinking Machines, data visualization tools in SAS Institute's MDDB, SGI MineSet, and Focus 6 Analysis and Visualization suite from Information Builders.

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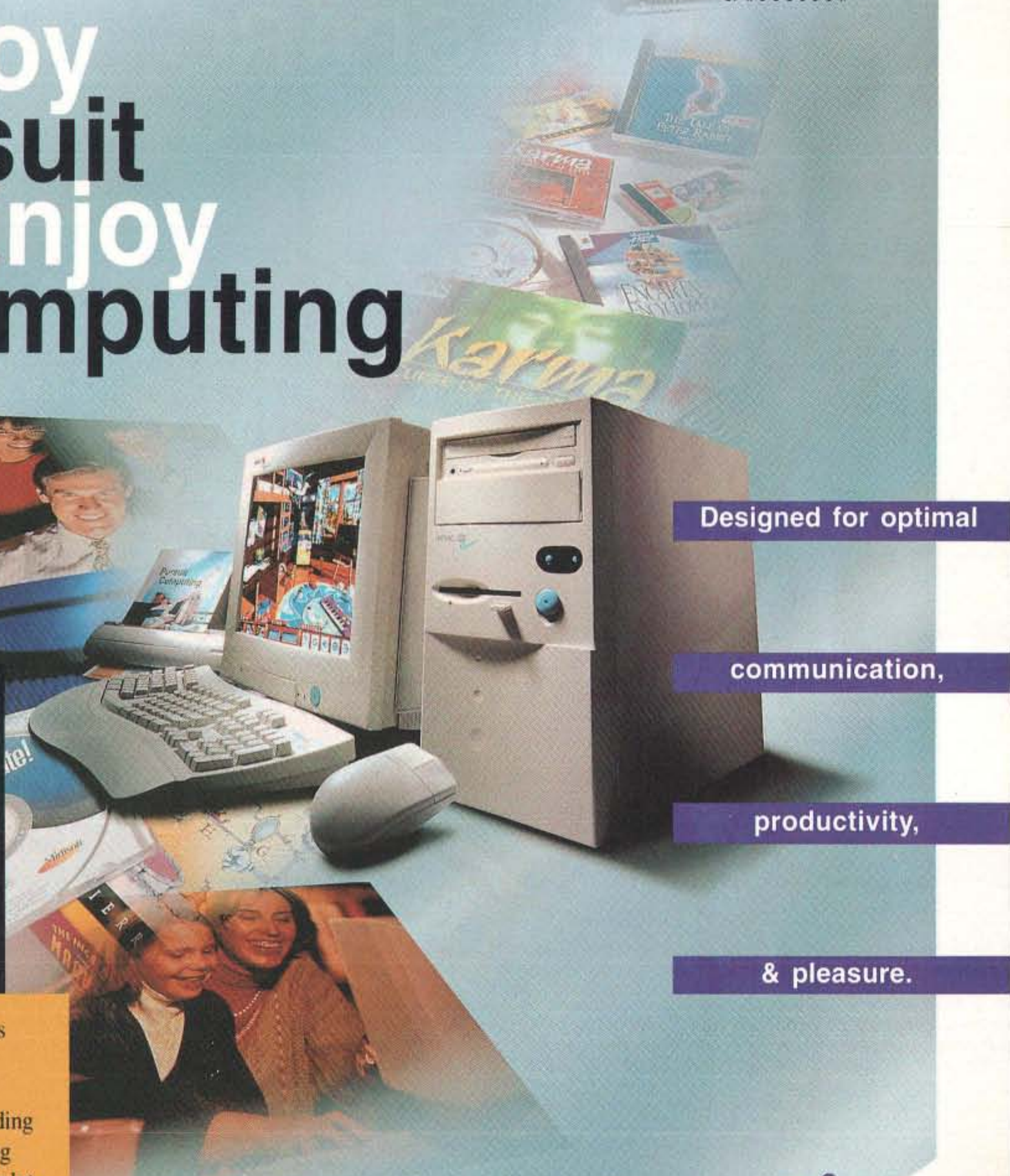
The Right Fit

There are some obvious rules to follow when choosing analysis tools. Match tools to end-user needs, corporate technical expertise, and your existing data sources. If you selected a warehouse vendor that also offers integrated tools, you will probably save significant development time by choosing a compatible tool set. Otherwise, select a tool set that supports your data sources natively. Without such support, you should opt for a relational OLAP solution since it does provide a more open architecture.

After you've selected a tool set compatible with your data sources, determine how much analysis you really need. If you just need to know "how much" or "how many," a basic query and reporting tool should be sufficient. If you require more advanced analysis that explains the cause and effect of occurrences and trends, look to an OLAP solution. Sophisticated data mining tools require expertise in data analysis techniques and are needed for advanced forecasting, classification, and pattern discovery.

As with any technology, no single solution or set of solutions can make your company perform better. Your staff must understand the requirements of technology, develop custom solutions that meet those requirements, and effectively maintain and upgrade the systems. Business intelligence software is only a tool. You still need managers and executives who can grasp the knowledge derived and make insightful decisions. In other words, business intelligence software still requires basic business intelligence.

Alan Simon is the technology manager for data warehousing at CoreTech Consulting Group (King of Prussia, PA). He's author of Strategic Database Technology: Management for the Year 2000 *(Morgan Kaufman, 1995). You can reach him at* **asimon@coretech-group.com.**



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RD10 RAID Storage Subsystem

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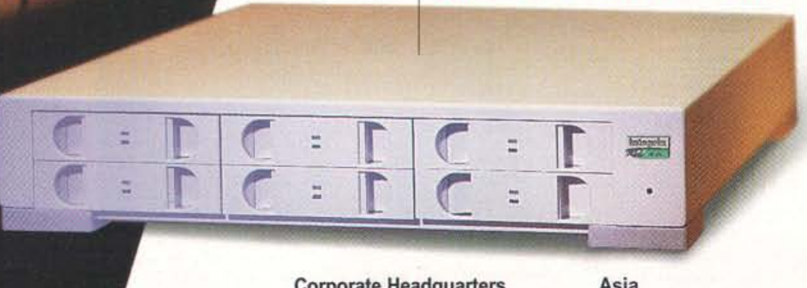

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Random Write (max)	13.0	357

RD10 RAID Subsystem Specifications

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Circle 231 on Inquiry Card.

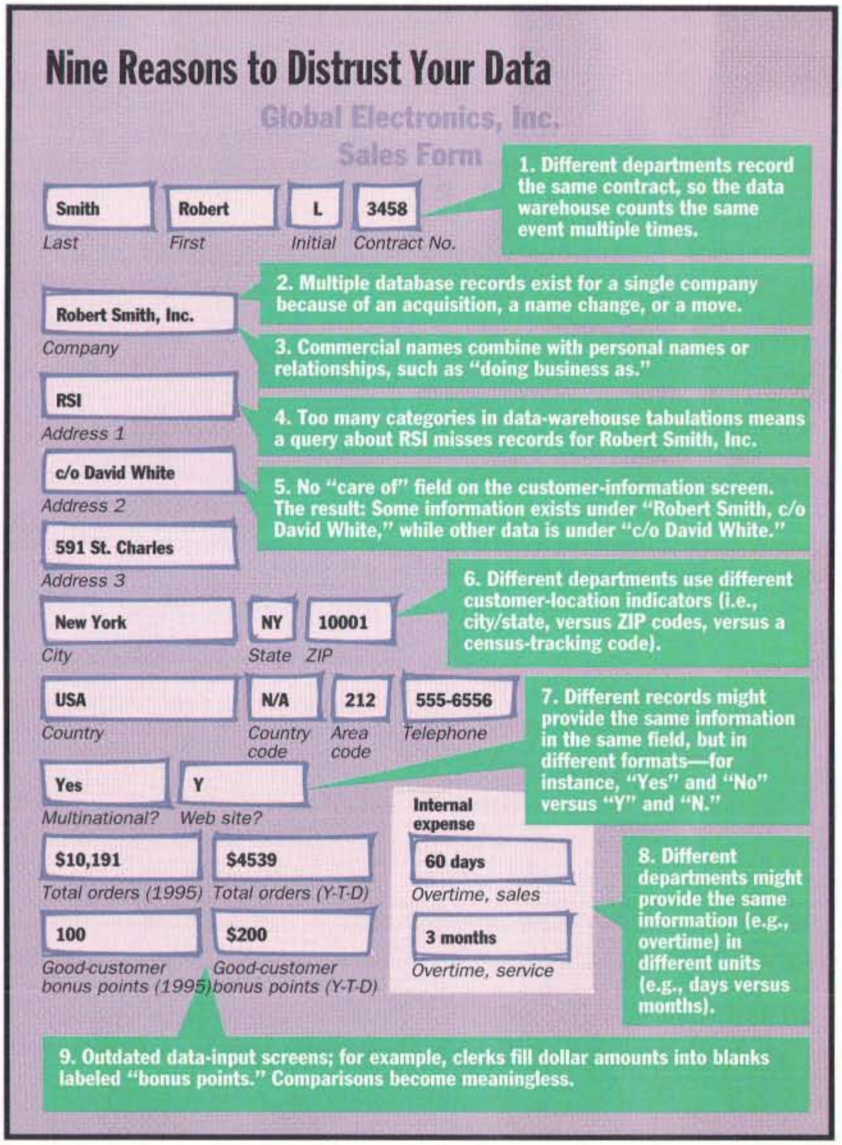
"Dirty" data is dangerous. Custom scripts and specialized cleansing tools provide safety nets. ***By Mike Hurwicz***

Take Your Data to the Cleaners

Garbage in, garbage out: It's one of the oldest rules of programming. No matter how well a program is designed or how skillfully it's used, if you feed it bad information you're going to get incorrect or misleading results. Unfortunately, even data that's been used successfully in operational line-of-business applications might be garbage as far as your data-warehouse application is concerned.

"Dirty" data can result from an innocent slip of a data-entry clerk's fingers (e.g., "Snadra White Enterprises" instead of "Sandra White Enterprises") or from a number of other causes (see the figure "Nine Reasons to Distrust Your Data" at right). No matter what the cause, dirty data damages the credibility of an entire warehouse implementation.

Fortunately, data-cleansing tools can help. In some cases, you might be able to create an effective cleansing script yourself. Commercial tools, on the other hand, might be mandatory if your database is large or especially inaccurate and inconsistent. Deciding which tool to use is important, and not only for the sake of data integrity. If you choose the wrong approach, you could squander weeks of programming resources or hundreds of thousands of dollars in tool costs.



Nine Reasons to Distrust Your Data

Global Electronics, Inc.
Sales Form

Smith	Robert	L	3458
Last	First	Initial	Contract No.

1. Different departments record the same contract, so the data warehouse counts the same event multiple times.

Robert Smith, Inc.
Company
RSI
Address 1
c/o David White
Address 2
591 St. Charles
Address 3

2. Multiple database records exist for a single company because of an acquisition, a name change, or a move.

3. Commercial names combine with personal names or relationships, such as "doing business as."

4. Too many categories in data-warehouse tabulations means a query about RSI misses records for Robert Smith, Inc.

5. No "care of" field on the customer-information screen. The result: Some information exists under "Robert Smith, c/o David White," while other data is under "c/o David White."

New York	NY	10001
City	State	ZIP

6. Different departments use different customer-location indicators (i.e., city/state, versus ZIP codes, versus a census-tracking code).

USA	N/A	212	555-6556
Country	Country code	Area code	Telephone

Yes	Y
Multinational?	Web site?

7. Different records might provide the same information in the same field, but in different formats—for instance, "Yes" and "No" versus "Y" and "N."

$10,191	$4539
Total orders (1995)	Total orders (Y-T-D)
100	$200
Good-customer bonus points (1995)	Good-customer bonus points (Y-T-D)

Internal expense

60 days
Overtime, sales
3 months
Overtime, service

8. Different departments might provide the same information (e.g., overtime) in different units (e.g., days versus months).

9. Outdated data-input screens; for example, clerks fill dollar amounts into blanks labeled "bonus points." Comparisons become meaningless.

Data warehouses are often more vulnerable to inaccurate or inconsistent data than operational applications are.

Data Cleaning

Cleaning up dirty data is a complex, multifaceted process that starts with an analysis of your corporate data to uncover inaccuracies, anomalies, and other problems. You then must transform the data to make sure it's accurate and consistently represented. Next comes the step of ensuring *referential integrity*, the ability of the data warehouse to correctly identify every instance of every business object, such as a product, a customer, or an employee. Next, you validate the data using the data-warehouse application to perform test queries.

After you're confident about the validity of your data, you need to produce *metadata*, a description of the data type, format, and business meaning of each field. Last comes the crucial step of documenting the whole process so you can more easily expand, modify, and repair the data in the future. In practice, you might have to perform multiple steps as part of a single operation or when using a single tool. In particular, cleaning data and ensuring referential integrity are interdependent processes.

Commercial tools can help you with each of these steps. However, it's possible to write your own programs to do the job. For example, CompuCom Systems, a large Dallas-based systems integrator, implemented a 12-million-record, 10-GB warehouse for internal decision support and for customers to view order-status and product information via the Web.

CompuCom implemented some data-enhancement routines in the fourth-generation language (4GL) associated with its Progress database, which runs on an HP 9000. Enhancement includes decoding values of columns into short English descriptions, or *mnemonics*. Data-scrubbing code, such as date and data-type conversions, was written in C. One advantage of this approach is that CompuCom now owns these routines and can use them in other applications.

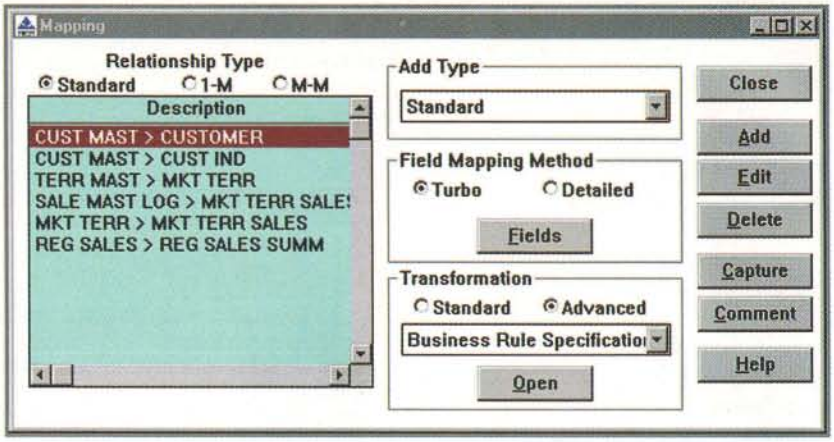
Users helped define the data-scrubbing requirements. "They know the data the best," says Tony Birrittier, data-warehouse project manager at CompuCom. "They inform us about what type of dirty data is out there and how to clean it."

Birrittier says the company didn't go with a commercial cleansing tool because most of its data is in the same basic form; thus, the company can easily reuse the routines it writes. The main drawback has been the amount of development time—typically about a week—needed to create the routines. "We're having a difficult time keeping up with demand," Birrittier explains. "We've been looking at some [commercial] software packages, but we haven't found anything on the market that's a better fit here at CompuCom."

Some users have found that in-house data scrubbing takes too long to be practical. Ohio Casualty Insurance (Hamilton, OH) experimented for two years with in-house cleansing, using COBOL programs, before turning to a commercial tool, the Integrity Data Reengineering Tool from Vality Technology.

The Ohio Casualty data warehouse combines records associated with about 1 million personal insurance policies, including auto and homeowner's policies. As a test run, the company started out with 3500 of its employees' policies.

"It's a total nightmare to try to program for all situations that you might run across," says Susan Parsons, Ohio Casualty's data administrator. Even after spending a year developing generic extract/transform/load programs, it took another year, using COBOL programming and manual editing, to get the policy data usable for the warehouse.



Relationship Type: ● Standard ○ 1-M ○ M-M

Description
CUST MAST > CUSTOMER
CUST MAST > CUST IND
TERR MAST > MKT TERR
SALE MAST LOG > MKT TERR SALE
MKT TERR > MKT TERR SALES
REG SALES > REG SALES SUMM

Add Type: Standard

Field Mapping Method: ● Turbo ○ Detailed

Transformation: ○ Standard ● Advanced

Business Rule Specificatio

The cleansing tools within warehouse management software, like Prism's, may be enough to solve anomalies in your database.

The Vality Integrity Data Reengineering Tool helps attack the first set of customer data—about 15,000 policies at the company's Denver business center. Although Ohio Casualty personnel still needed to comb through anomalies that the Vality product discovered, no programming or manual editing of the data was required. The data was ready for the warehouse in about six weeks.

Intel (Hillsboro, OR) is an example of a company that has successfully done some in-house data cleaning, though against its will. Intel originally intended to outsource its data cleansing to a service bureau, for a customer-contact warehouse of approximately 1 million records taken from five operational systems. The service bureau promised to identify relationships among various groups within customer companies. In addition, the bureau would provide industry information for customer organizations, such as number of employees, revenues, and growth, which would be valuable to Intel's sales and marketing people. Unfortunately, the service bureau did not do a perfect job of identifying relationships among customers because some contact people became associated with the wrong companies.

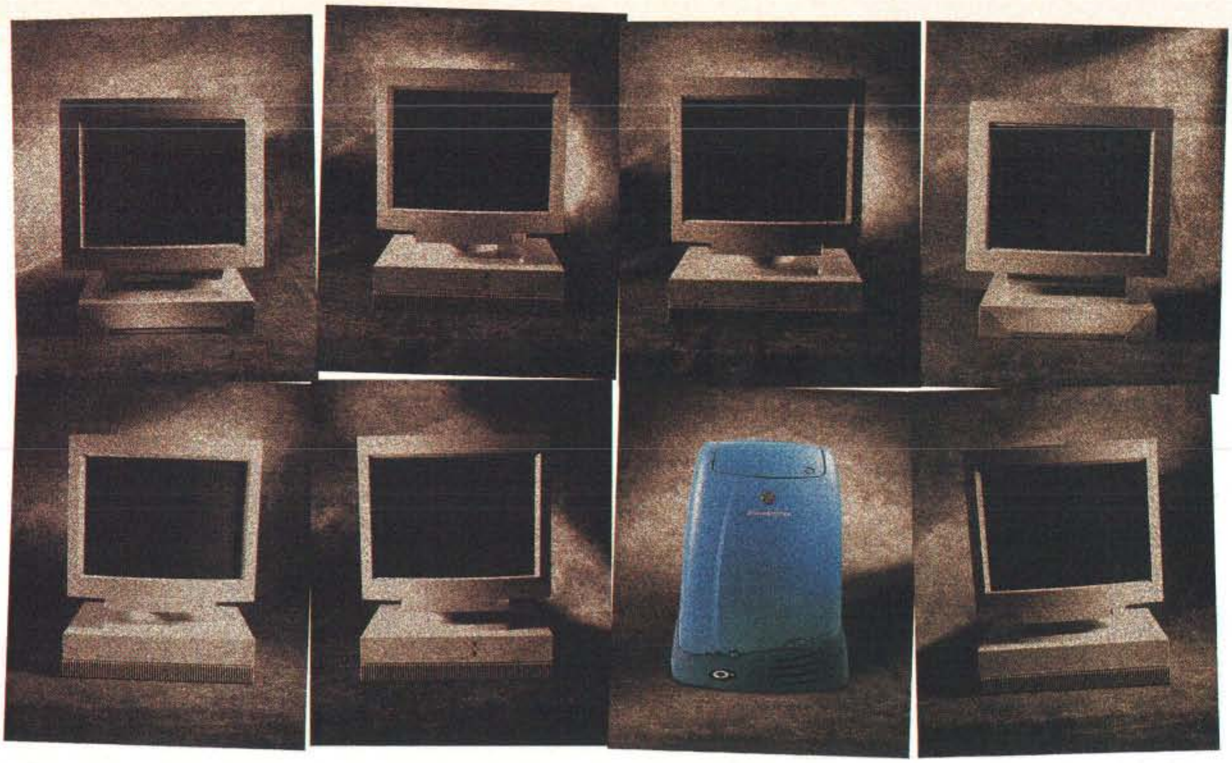
Intel took the tape it got back from the service bureau and then ran the data through the SAS statistical-analysis package, from the SAS Institute, to identify and correct problems with the relationships in the top 10 groupings (i.e., those with the most companies in a single relationship hierarchy). The company then used Oracle database tools to do further analysis and cleansing. Since new data was coming in all the time, some of the Oracle cleansing routines were implemented as stored procedures so that they could automatically be run against new data.

Intel would still like to outsource the data-cleaning task. However, the company plans to keep it in-house until it finds an acceptable service bureau.

Many companies also turn to consultants for custom solutions. For instance, CrediCard (São Paulo, Brazil), a large credit-card issuer in South America, got data-scrubbing and enhancement tools as part of a data-warehouse implementation by Market Knowledge, a subsidiary of Equifax. CrediCard's marketing personnel use approximately 200 custom routines to perform cleansing operations, such as removal of bad or useless data, correction of bad values, and standardization of varying formats. In addition, they can enhance data by performing such operations as correcting monetary amounts for inflation and devaluation, creating a virtual age field based on a person's birth date, and appending census data to incoming records.

These custom routines (e.g., inflation correction) are particularly suited to Brazilian requirements. They are also designed for use by nontechnical marketing personnel. The data-scrubbing routines, which are programmed as SQL commands, took only about three person-weeks to create—a negligible portion of a 2½-year project. (Data-enhancement tools, which are more automated and more intelligent, represent about $120,000 of the total $840,000 job.)

continued



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Circle 234 on Inquiry Card.

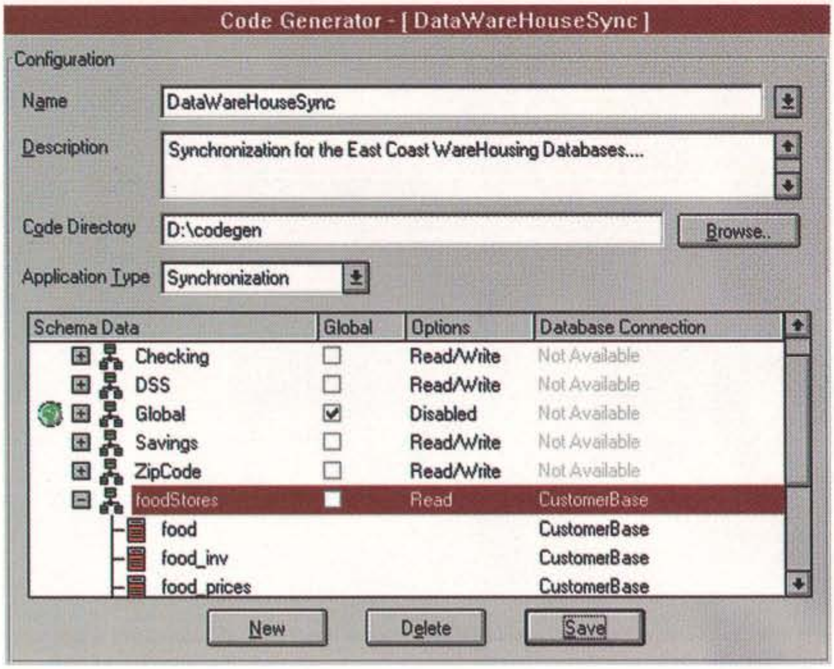
Data-scrubbing scripts don't provide much intelligence, so firms need to manually provide the decision-making, based on top-line and data-audit reports. Each time a new set of data is loaded, data scrubbing usually constitutes about 25 percent of what is perhaps a four-week process.

Light Cleaning

Even if you decide not to program data-cleansing functions yourself or hire a consultant to do a custom job, you may not need to buy a tool specifically for the task: Your data-warehouse management software might do enough cleaning and validation for your purposes. Many data-warehouse projects rely on a product such as Warehouse Manager, from Prism Solutions, or Passport, from Carleton, for a range of data-warehouse management tasks, including extracting data from operational databases, preparing data for loading into a warehouse database, and managing metadata. These products, which cost from $75,000 to more than $200,000, depending on the size and complexity of the project, can also do cleaning, transformation, and validation.

For instance, Emory University (Atlanta) does all the data cleansing for its 6-GB warehouse with COBOL programs generated by the Prism Warehouse Manager. In addition to having typical problems, such as multiple date formats, data often contains uninitialized fields that hold arbitrary values. Two staff members spend as much as 4 hours a day working on data-cleansing tasks. Emory has considered using specialized data-cleansing tools, but the school is eliminating dirty data well enough now that it doesn't see enough additional value in other commercial products to justify the cost, according to Barbara Germon, manager of the data-resources group.

However, there's a good chance that the aforementioned tools from Prism and Carleton won't do all the cleaning you need. They might be able to deal with common anomalies that can be handled through simple lookup tables (e.g., recognizing that *Street* and *St.* represent the same information), but they might not deal successfully with more important and unpredictable irregularities. "It's worth doing some testing," says Wayne Eckerson, a senior consultant at the Patricia Seybold Group in Boston, Massachusetts, "but these tools are not designed to do 'heavy-lifting' types of cleaning."



Name: DataWareHouseSync

Description: Synchronization for the East Coast WareHousing Databases....

Code Directory: D:\codegen

Application Type: Synchronization

Schema Data	Global	Options	Database Connection
Checking	☐	Read/Write	Not Available
DSS	☐	Read/Write	Not Available
Global	☑	Disabled	Not Available
Savings	☐	Read/Write	Not Available
ZipCode	☐	Read/Write	Not Available
foodStores	☐	Read	CustomerBase
food			CustomerBase
food_inv			CustomerBase
food_prices			CustomerBase

With Apertus's Enterprise/Integrator, you impose your firm's business rules on a database to wipe out anomalies in the data.

If the data that requires cleaning consists predominantly of names (including company names) and addresses, companies such as Harte-Hanks Communications and Innovative Systems provide not only software tools but periodically updated data files to help match variants of company names, detect ZIP codes that don't match the addresses provided, and deal with similar anomalies. These tools might be appropriate where, for instance, fields other than those for names and addresses are either known to be correct (e.g., contract dollar amounts that have been validated by accounting) or contain free-form information that will never be used as a key or index (e.g., salespeople's contact notes).

Name-and-address-oriented solutions can cost anywhere from $30,000 to more than $200,000, depending on the size of the data warehouse in question. In addition, an extract/transform/load (ETL) tool, such as Warehouse Manager or Passport, is also needed.

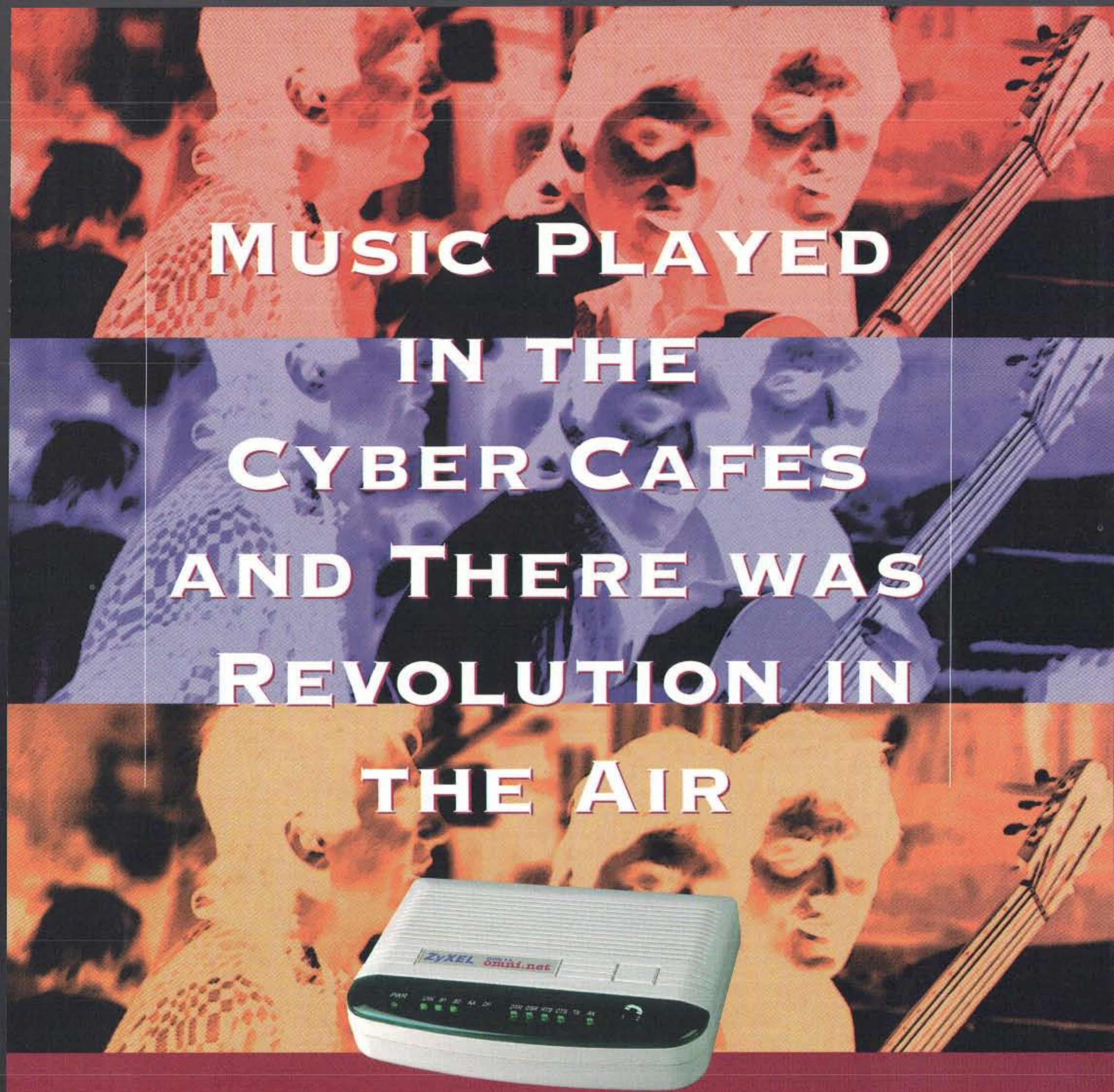
The Heavyweights

For extensive cleaning jobs, consider tools that are developed for that task. Two top contenders are Enterprise/Integrator, from Apertus Technologies, and Vality's Integrity Data Reengineering Tool.

Enterprise/Integrator takes a top-down approach, in which you have to provide the rules for cleaning the data. This is a straightforward strategy, where you impose your understanding about your business on the data. For instance, do you wish to treat a string of Martha's Fried Chicken franchises as a single customer with multiple addresses? Or, for the purposes of the data warehouse, does it make sense to substitute a single central address for the different franchise addresses? Or would you like to treat the franchise locations as entirely different customers? This decision determines how you aggregate or consolidate these records and whether you treat differing addresses for Martha's Fried Chicken as anomalies.

Enterprise/Integrator offers not just data cleaning, but also extraction, transformation, data loading, replication, synchronization, and metadata management. It's fairly expensive ($130,000 to $250,000), but it can be a money-saver if it eliminates the need for other data-warehouse management tools.

The main disadvantage to Enterprise/Integrator's top-down approach is that you have to know, or be able to deduce, the data-cleansing and business rules. Apertus provides samples to work from, which deal with many common anomalies and business structures. Still, creating rules is time-consuming, and you're



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sure to find some unexpected anomalies. These can be handled manually through an exception-handling system—but it's a time-consuming process.

Vality's Integrity Data Reengineering Tool takes a bottom-up approach. It analyzes the data character by character and automatically surfaces patterns and business rules. Integrity then provides a data "blueprint" to help standardize, condition, and consolidate the data. This approach tends to leave fewer exceptions to be handled manually, and the process tends to be less time-consuming.

Like Enterprise/Integrator, Integrity can take into account business relationships that aren't obvious from the data, such as mergers and acquisitions that have taken place since the data was created. But with either tool, these rules must be imposed in a top-down fashion.

Integrity focuses exclusively on data cleansing, starting from flat files. It does not extract data from operational databases, load data into the warehouse database, replicate and synchronize data, or manage metadata. Therefore, in addition to typically costing $250,000, Integrity might also require a tool like Warehouse Manager or Passport. But the simple extraction/load utilities available with the database might be sufficient for you.

Facing the Threat

Dirty data is a serious threat to the success of a data-warehouse project. Depending on the extent of the problem, it simply might not be possible to address it quickly, inexpensively, and well.

In-house programming takes time; serious tools are expensive. Warehouse project managers need to realistically assess the problem, and the in-house resources available to deal with it, and select the solution that fits the schedule and the budget of the project—or modify the schedule and the budget to fit the problem. **B**

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Big Screens for Big Jobs

A big, high-quality display can make a long day shorter. We test 38 monitors.

By Dorothy Hudson, Jim Kane, and John McDonough

It shouldn't take a case of eyestrain or even undue scrolling to justify a good monitor these days. With some high-quality 17-inch displays now selling for around $700, there's no reason why any computer professional can't enjoy more-panoramic views of spreadsheets and Web sites.

At prices hovering around $2000, larger, 19- to 21-inch screens are still reserved for desktop-publishing, imaging, graphics, and CAD applications. But even with these higher-end monitors, prices average several hundred dollars lower than when we last looked at 21-inch displays (see "20 Big-Picture Monitors," January 1996 BYTE).

For this hands-on Lab Report, we tested 38 professional-quality monitors with nominal 17- to 21-inch screen diagonals. We ran the lot through NSTL's battery of screen-quality tests using side-by-side comparisons; evaluated ease of use and feature sets; and measured power consumption. The monitors fell into two size classes: 17-inch and 19- to 21-inch. For the 17-inch group, the average price is around $850; for the 19- to 21-inch class, the average price is just under $2000.

Picture Quality

We asked companies to send us monitors that were capable of achieving at least a 75-Hz refresh rate at 1280- by 1024-pixel resolution. (As it turned out, not all the models that we tested were able to do this.) The higher the refresh rate, the less likely you are to suffer from the eyestrain and headaches that perceived flicker can induce. While some people are more sensitive to flicker than others are, 75 Hz is high enough for most people.

Larger monitors should have higher refresh rates because more of the image appears in your flicker-sensitive peripheral vision. Cornerstone's Color 50/115 and ViewSonic's P815 can both support an 87-Hz vertical-refresh rate at 1600 by 1200 resolution—if you can find a graphics card that's able to drive that high a pixel rate. (We didn't test the monitors at this resolution.) These two monitors do this by pushing scanning frequencies to new levels—up to a 115-kHz horizontal scan rate and a 250-MHz video bandwidth (see the Tech Focus on page 105). Both monitors support an amazing 1800 by 1440 screen resolution. But supporting these rates is electronically challenging, which accounts for the monitors' high prices (around $2200).

BYTE BEST
MONITORS

Best 17-inch:
Art Media TN-1885T

Best 21-inch:
NSA/Hitachi SuperScan Elite 802

These two monitors provided the best combination of display quality, features, usability, and price in their respective size classes.

Different monitors often have the same picture-tube manufacturer; approximately two-thirds of the tested models incorporate either Hitachi or Sony tubes, for example. But that doesn't mean that they provide the same image quality. The electronics that produce and control the image-painting electron beams have a big effect on picture quality, and there can be great differences between designs that use the same tube.

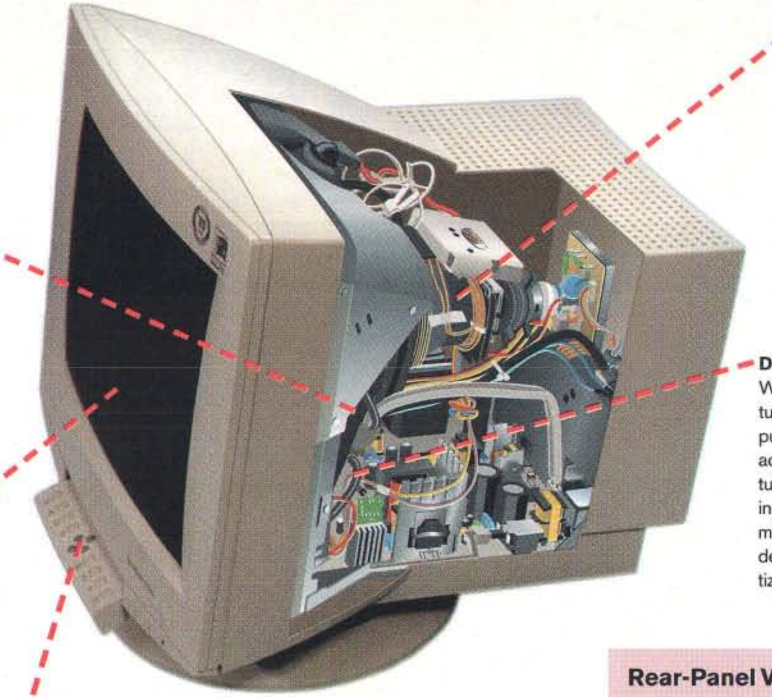
In addition, there are two basic tube types that affect image appearance, based on the type of shadow mask used to make each beam strike the correct color phosphor dots (red, green, or blue). The most common tube type uses a metal screen (a thermally stable Invar alloy) that's laced with dots that correspond to similarly arranged phosphor dots on the inside of the glass screen. Also common is Sony's Trinitron design (now licensed by other companies), which employs an aperture grille—a vertical array of wires stretched across the screen that shadows vertical lines of colored phosphor.

Some people prefer dot-shadow masks for their pixel uniformity, while others prefer aperture-grille designs for their high contrast. Overall, the aperture-grille tubes did well in our image-quality tests.

Electronics have also made monitors easier to use. Most models now have advanced controls with on-screen menus for adjusting the picture just the way you want it. You can often adjust such things as pincushioning, barrel distortion, and color matching. Some monitors even provide focus and convergence adjustment, important because large monitors slip out of their best adjustment setting over time.

Power and Configuration

Large monitors use lots of power—more than any other device on your desktop. We measured power-consumption values ranging from 79.8 to 128.5 W, in ac-



TUBE
The most common type of tube uses a dot mask made of Invar, a steel/nickel alloy that keeps its shape with temperature changes. Trinitron-type tubes use a vertical array of tensed wires to shadow the screen phosphors—preventing the "red" electron beam from hitting the green and blue screen phosphors, for example.

SCREEN SURFACE
Today's high-tech screen coatings reduce reflection and glare without degrading image sharpness.

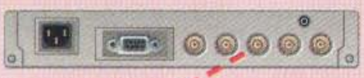
CONTROLS
A minimum of buttons should allow you to intuitively work through pop-up on-screen menus so that you can adjust just about anything that's adjustable.

DEFLECTION SYSTEM/YOKE
A series of coils wrapped around the neck of the picture tube that deflect the electron beams—horizontally to produce the line scan, and vertically to produce the field or frame scan.

DEGAUSSING COIL
Wraps around the picture tube. The earth's magnetic pull and movement of the active display cause the picture tube to magnetize, resulting in image distortion. When momentarily activated, the degaussing coil demagnetizes the picture tube.

This illustration is based on the Samsung Synchmaster 17GLsi.

Rear-Panel View



BNC CONNECTORS
At higher scanning frequencies (i.e., high resolutions and refresh rates), coaxial cables that connect to BNC connectors provide cleaner video signals.

ILLUSTRATION: SANDERS/TIKKANEN DESIGN & ILLUSTRATION © 1997

tive mode with a full Windows screen. All tested monitors have built-in Video Electronics Standards Association (VESA) Display Power Management System (DPMS) electronics, a feature that allows the host system to switch the monitor to a low-power mode that consumes less than 30 W, or into a sleep mode, where the monitor consumes less than 8 W. With few exceptions, we found that the monitors power down as advertised.

All tested monitors provide Windows 95 Plug and Play support, and we had no problems setting them up. Plug and Play monitors support the Display Data Channel (DDC) specification, so the monitor and the host computer's graphics card and OS can all communicate. The end result is that the monitor can provide Win 95 with the resolution and refresh-frequency combinations it supports, and you get the most flicker-free mode at a given screen resolution.

In addition to the standard 15-pin D-sub cable interface, some monitors have BNC connectors that accept video signals over a set of coaxial cables, often one for each video signal (red, green, blue, vertical sync, and horizontal sync). Coaxial cables reduce signal noise by shielding the video-input signals from each other and from extraneous electromagnetic noise. If you use BNC cables, however, you don't get Plug and Play.

TECH FOCUS FREQUENCIES

The Pause That Refreshes

Perusing a monitor's glossy spec sheet and seeing that it supports 1600- by 1200-pixel resolution and refresh rates as high as 120 Hz does not mean that you can get that high resolution at 120 Hz, or even at a solid 80-Hz refresh rate. The refresh rate that a monitor can support goes down as the resolution goes up. What you need, and what some spec sheets provide, is a list of screen resolutions with their maximum refresh rates. But without this list, you can still gauge a monitor's capabilities by examining two other frequency specifications.

While a monitor's maximum vertical-refresh frequency tells you little, the horizontal scanning frequency (in kHz) and video bandwidth (in MHz) are reliable measures of what a monitor can do. Maximum horizontal scan rate describes the rate at which a monitor can write rows of pixels down the screen; video bandwidth is the rate (roughly) at which a monitor can pump pixels onto its screen surface. As the resolution goes up, a monitor has to write more pixels (and rows of pixels) with every vertical screen scan. The higher the vertical-refresh rate, the more times it has to paint that screenload of pixels per second. Monitor spec sheets don't always list supported video modes, but they always supply scanning-frequency ranges.

Guideline Frequencies

Thumbnail specs for two high-resolution modes.

MODE	HORIZ. SCAN RATE	BANDWIDTH
1280 × 1024 (75 Hz)	85 kHz	120 MHz
1600 × 1200 (75 Hz)	95 kHz	200 MHz

Best Overall

PROFESSIONAL MONITORS

Year after year, monitor manufacturers refine display quality while shaving off dollars from the price you pay for that quality. Electronics that are more sophisticated and more integrated (which reduces the number of parts) account for both trends. Electronics have also increased ease of use by allowing on-screen adjustment control. While judging among the 38 monitors, we put a heavy weighting on display quality. You adjust a display only occasionally, but you look at it every day—usually for hours at a time.

The 17-inch monitors with the best picture quality in our tests were the Art Media TN-1885T and the Nokia Display Products Multigraph 447Xi. Four 21-inch monitors shined the greatest in our image-quality tests: Cornerstone Imaging's Color 50/115, the NEC MultiSync P1150, NSA/Hitachi's SuperScan Elite 802, and the ViewSonic P815. Not surprisingly, these monitors had the highest refresh rates and exhibited the best corner and full-screen image sharpness, RGB convergence, and legibility in our benchmarks.

The Top 17-inch Monitors

We tested 24 17-inch monitors, ranging in price from $649 (for the Max Group's MGC 1785) to $1299 (for Eizo Nanao's Flexscan TX-C7S). Some of the higher-cost 17-inch monitors support 1600- by 1200-pixel resolutions, but unless you're doing CAD or similar high-resolution work, you'll probably find the text more readable—and the refresh rate higher—at 1024 by 786 resolution.

Several 17-inch monitors rose above the pack (though not by much) when we crunched the numbers from our image-quality, power-management, features, and usability tests. The Art Media TN-1885T ($1088) was rated highest among the 17-inch monitors, but several lower-cost displays weren't far behind.

Next in the pecking order is Mitsubishi's Diamond Pro 17TX ($849), which features a Mitsubishi-manufactured Diamondtron CRT with a 0.25-mm slot-pitch-aperture grille mask. The Diamond Pro 17TX produces well-focused images, and it has a fairly high 135-MHz video bandwidth that can drive 1280 by 1024 pixels at a 75-Hz refresh rate.

Mitsubishi's monitor gets high features and usability ratings: Its on-screen display-control system provides extensive adjustments. It also comes with Mitsubishi's Diamond Match Color Calibration System. Mitsubishi's other entry—the Diamond Scan 17HX ($799)—is also a good buy that scored in our top five.

The Max Group's MGC 1785, one of the best 17-inch monitors, is also one of the lowest priced ($649). The MGC 1785's bright, clear display is better than that of most of the 17-inch models we tested. It has a 0.26-mm-dot-pitch picture tube from Hitachi that delivers 1600 by 1200 resolution at 65 Hz, although we found the flicker-free 1024 by 768 mode more to our liking.

The MGC 1785 offers well-placed image-adjustment controls with an easy-to-peruse on-screen menu. Two other lower-cost monitors also deserve mention as good choices for home systems: LG Electronics' Studioworks 78i ($679) and KDS's VSX-7 ($649).

Another hot 17-inch monitor is Nokia Display Products' Multigraph 447Xi ($899). This monitor produced the second-best image quality among the 17-inchers: It's sharply focused and flicker-free at an 85-Hz refresh rate with a

Test Specs

We tested each monitor's image quality and power consumption using a 200-MHz Dell Dimension XPS Pro200n with a Number Nine Imagine 128 Series II graphics card. When available, we used monitor-specific drivers, but otherwise we stuck with Windows 95 Plug and Play (VESA standard) settings. We scored image quality at 1024- by 768-pixel resolution for the 17-inch monitors and at 1280 by 1024 for the 19- to 21-inch displays.

Under DOS, we tested image quality using Displaymate Professional 4.2 from Sonera Technologies ((800) 932-6323; http://www.displaymate.com). Tests included color and gray-scale displays, blooming effects on color and black-and-white text, moiré patterns at multiple resolutions, consecutive text and graphics switching, and geometric display of rectangles and circles.

Under Win 95, we ran NSTL test software to measure an image's sharpness, misconvergence, and legibility. We measured sharpness using 1- and 2-pixel-thick lines near the screen edges. We also displayed horizontal and vertical lines across the entire screen to judge a monitor's resolving capability.

An optical gauge from Klein Optical Instruments ((503) 245-8166) allowed measurement of misconvergence. With three prisms, the instrument reconverges the red, green, and blue components of a white line displayed on the test monitor. We calculated the amount of misconvergence from the amount of correction required; the less misconvergence, the better.

In our legibility test, we displayed a document containing six TrueType fonts at sizes ranging from 4 to 14 points. We then judged the smallest point size at which each font remained both readable and legible from a normal distance.

Your monitor is the biggest power hog on your desktop. We rated each monitor's power use under Windows, measuring consumption in three states (active Windows, blank screen-saver, and low-power) with a digital power meter.

Weighted factors in our features score include dot pitch, range of scanning frequencies, number of display modes, controls, and Energy Star compliance. The usability score took into account such factors as documentation, technical support, ease of adjustment, and cable lengths.

THE CLEAR CHOICE

EDITORS' CHOICE

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LAB RESULTS

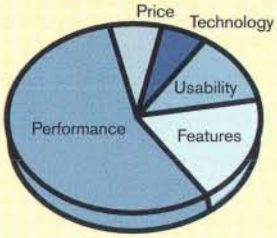
MONITOR RATINGS

BEST 17-INCH MONITOR

Art Media TN-1885T

The Art Media TN-1885T has the best image-quality score among the 17-inch monitors we tested, and that helped it take the category. The TN-1885T also gets high features and usability marks. Using its drop-down control panel, you can adjust almost anything, ranging from brightness to color temperature.

WEIGHTING



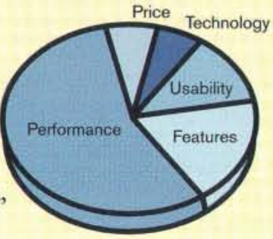
	PRICE	SIZE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	USABILITY	FEATURES	POWER ECONOMY	OVERALL RATING
Art Media TN-1885T	**$1088**	17	★★★★	★★★★	★★★★★	★★★★	★★★★	★	★★★★
Mitsubishi Diamond Pro 17TX	$849	17	★★★★	★★★★	★★★★	★★★★★	★★★★★	★★★	★★★★
Max Group MGC 1785	$649	17	★★★★	★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
Nokia Multigraph 447Xi	$899	17	★★★★	★★★★	★★★★★	★★★★★	★★★	★★★	★★★★
Mitsubishi Diamond Scan 17HX	$799	17	★★★★	★★★★	★★★★	★★★★★	★★★★★	★	★★★★

BEST 21-INCH MONITOR

NSA/Hitachi SuperScan Elite 802

NSA/Hitachi's SuperScan Elite 802 had the best image quality among the big-screen displays we tested, and its price is low. The monitor has a Hitachi Invar shadow-mask picture tube with a 0.26-mm dot pitch that supports 1600- by 1280-pixel resolutions at a 75-Hz refresh rate. The picture is super-solid at 1280 by 1024 resolution, with 114-Hz redraws.

WEIGHTING



	PRICE	SIZE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	USABILITY	FEATURES	POWER ECONOMY	OVERALL RATING
NSA/Hitachi SuperScan Elite 802	**$1899**	20	★★★★	★★★★	★★★★★	★★★★	★★★	★★★	★★★★
ViewSonic P815	$2195	21	★★★★	★★★★	★★★★★	★★★★★	★★★	★★	★★★★
NEC MultiSync P1150	$2079	21	★★★★	★★★★	★★★★★	★★★	★★★★	★★★★★	★★★★
Cornerstone Color 50/115	$2265	21	★★★★	★★★★	★★★★★	★★★★	★★★	★★	★★★★
Panasonic PanaSync S21	$1799	21	★★★★	★★★★	★★★★	★★★★★	★★★	★	★★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

resolution of 1024 by 768. The Multigraph 447Xi has a Sony Trinitron 0.25-mm aperture-grille tube and provides an on-screen menu for color-matching and adjusting any geometric distortions.

The Top 21-inch Monitors

The 14 21-inch monitors that we tested are obviously not just for the common task of viewing spreadsheets or word processing documents. Many support 1600- by 1200-pixel and higher resolutions, which, on a 21-inch screen, are useful mainly for rendering detailed images for CAD users and for desktop publishers who need to clearly see a whole page or two when doing layout and design. We gave NSA/Hitachi's SuperScan Elite 802 the nod as our top 21-inch monitor, but you should also check out the following displays.

The ViewSonic P815 ($2195) carries a high price tag, but it supports extremely high resolutions that CAD engineers and graphic designers with high-end graphics cards can push to the limits. This 0.25-mm-dot-pitch monitor by far exceeds the needs of the average spreadsheet and word processor user when set at its maximum resolution of 1800 by 1440. The big monitor has a fast 106-Hz refresh rate at the more-standard resolution of 1280 by 1024, and its 250-Hz video bandwidth is one of the highest. The P815 received a high usability score because its controls are easy to use, the monitor tilts and swivels smoothly, and it comes with a good user's manual.

NEC's MultiSync P1150 ($2079), which was tied with Cornerstone Imaging's Color 50/115 ($2265) for second-best overall image quality among the 21-inch displays, showed little misconvergence and effectively mixed color combinations in our benchmarks. This 21-incher supports 1600- by 1200-dpi resolutions at 75 Hz, but NEC recommends a resolution of 1280 by 1024 with an 88-Hz refresh rate. When not in use, the P1150 powers down to save energy in the most economical manner of all the monitors in this roundup.

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MONITORS FEATURES

	Acer America Corp. AcerView 78ie	Apple Computer, Inc. AppleVision 1710	Apple Computer, Inc. Multiple Scan 20	Art Media TN-1885T BYTE BEST	Art Media TN-2185T	Cornerstone Imaging, Inc. Color 21/81fp	Cornerstone Imaging, Inc. Color 50/115	CTX International, Inc. PR700	Daewoo Electronics CMC1704C
Price as tested (MSRP)	$699	$949	$1999	$1088	$1888	$2070	$2265	$999	$699
Nominal size (inches, diagonal)	17	17	20	17	20	21	21	17	17
Overall rating	8.1	8.4	8.5	8.8	8.5	8.6	8.8	8.3	7.6
Performance score (display quality)	8.3	8.4	8.8	9.2	8.6	9.0	9.4	8.5	7.7
Features score	7.4	8.0	7.3	8.2	8.4	7.1	7.1	8.0	7.4
Usability score	7.3	9.9	8.7	8.7	8.3	9.0	8.8	8.5	8.3
Power-economy score	5.1	6.2	6.3	4.1	6.8	7.5	6.5	4.3	5.2
CRT SPECIFICATIONS									
Viewable size (inches, diagonal)	15.7	16.1	19.1	16.0	19.1	19.9	19.9	16.0	16.1
Screen surface (A = antiglare; B = antistatic; C = antireflective)	B, C	A, B	A, B	A, B, C	A, B, C	A, B	A, B	A, B, C	A, B
Dot/grille pitch (mm)	0.26	0.26	0.26	0.25	0.25	0.27	0.27	0.26	0.26
Dot-mask type	Shadow mask	Aperture grille	Aperture grille	Aperture grille	Aperture grille	Shadow mask	Shadow mask	Aperture grille	Shadow mask
Max. noninterlaced horizontal × vertical resolution (pixels)	1600 × 1200	1600 × 1200	1600 × 1200	1600 × 1200	1600 × 1200	1600 × 1280	1800 × 1440	1600 × 1200	1600 × 1200
SYNC-INPUT SIGNALS									
Min./max. horizontal scanning frequency (kHz)	30/86	30/80	29/82	30/85	30/85	31/101	31/115	30/85	24/86
Min./max. vertical scanning frequency (Hz)	50/120	40/120	50/150	48/150	48/150	50/160	50/160	50/120	50/150
VIDEO-INPUT SIGNAL									
Video bandwidth (MHz)	135	INP	INP	50–100	50–100	211	249	135	120
Separate RGB, 0.7-V p-p	✓	✓	✓	✓	✓	✓	✓	✓	✓
Input connector (15-pin D-sub)	✓	✓	✓	✓	✓			✓	✓
Input connectors (BNC–RGB, HD, VD)				✓	✓	✓	✓	✓	✓
DISPLAY MODE									
Number of factory-preset modes/ user-settable modes	11/21	10/5	9/4	10/15	15/15	7/26	7/26	15/15	16/20
640 × 480 Mac II mode (max. noninterlaced vertical-refresh rate, Hz)	66.7	67	67	60	60	N/A	N/A	120	66.7
832 × 624 Mac 16-inch mode (max. noninterlaced vertical-refresh rate, Hz)	75	75	75	75	75	N/A	N/A	120	76.8
1024 × 768 mode (max. noninterlaced vertical -refresh rate, Hz)	75	60	60	85	85	85	85	106	75
1152 × 870 Mac II two-page mode (max. noninterlaced vertical-refresh rate, Hz)	75	75	75	75	75	N/A	N/A	76	75
1280 × 1024 mode (max. noninterlaced vertical-refresh rate, Hz)	80	75	75	75	75	85	85	75	76
1600 × 1200 mode (max. noninterlaced vertical-refresh rate, Hz)	68	60	60	60	60	81	87	68	60
CONTROLS									
Degauss	✓			✓	✓	✓	✓	✓	✓
Focus				✓	✓				
Convergence		✓	✓	✓	✓			✓	✓
Signal level				✓	✓				✓
Side convergence (pincushioning)	✓	✓	✓	✓	✓	✓	✓	✓	✓
On-screen monitor settings	✓	✓		✓	✓	✓	✓	✓	✓
Color matching	✓	✓		✓	✓	✓	✓	✓	
PHYSICAL CHARACTERISTICS									
Integrated speakers									
Power input (volts AC)	90–264	90–264	90–264	120–240	120–240	110–120/ 200–240	110–120/ 200–240	100–250	100–240
VESA DPMS–compliant	✓	✓	✓	✓	✓	✓	✓	✓	✓
Height × width × depth (inches) × weight (lbs.)	16.5 × 16.6 × 16.7 × 40	19.7 × 15.9 × 17.7 × 50	18.6 × 18.6 × 19.8 × 67	17 × 16 × 17.8 × 44	19 × 18 × 19 × 65	18.7 × 19.2 × 21 × 72.6	18.7 × 19.2 × 21 × 72.6	17.2 × 16.5 × 17.5 × 46.3	17.6 × 16.8 × 17.7 × 44.5
FCC rating	B	B	A	B	B	A	A	B	B
TCO-compliant	✓	✓	✓	✓	✓	✓	✓	✓	
CUSTOMER SUPPORT									
Warranty length (years)/coverage	3/P, L, R	1/P, L, F	1/P, L, F	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R
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BYTE BEST = BYTE Best.

✓ = yes; N/A = not applicable; INP = information not provided.

Warranty: P = parts; L = labor; F = freight to repair center; R = return to customer.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Daytek Electronics Corp. DT-1704C	**Eizo Nanao Technologies, Inc. Flexscan TX-C7S**	**Hansol Multitech Hansol 17PX**	**Hitachi America, Ltd. HM-4787D**	**Hitachi America, Ltd. HM-4921-D**	**KDS U.S.A. VSX-7**	**LG Electronics USA, Inc. Studioworks 78i**	**MAG InnoVision, Inc. DX700T**	**MAG InnoVision, Inc. MX21F**	**Max Group Corp. MGC 1785**	**Mitsubishi Electronics America Diamond Pro 17TX**	**Mitsubishi Electronics America Diamond Scan 17HX**
$799	$1299	$895	$1769	$2129	$649	$679	$799	$1799	$649	$849	$799
17	17	17	21	21	17	17	17	21	17	17	17
8.3	8.0	8.2	8.5	8.5	8.5	8.5	7.9	8.4	8.7	8.7	8.6
8.3	8.8	8.6	8.8	8.9	8.8	8.8	8.2	8.5	8.7	8.7	8.5
8.0	7.6	6.2	7.3	7.6	7.3	7.2	6.8	7.7	8.2	8.8	8.8
8.5	5.3	9.0	8.6	8.3	8.3	8.2	7.8	8.6	9.0	9.4	9.0
5.2	4.4	5.2	5.8	6.0	5.4	5.1	4.4	5.8	8.1	6.9	4.8
16.4	15.9	15.7	20.0	20.0	15.8	16.0	16.2	20.0	14.6	15.9	15.7
A, B, C	C	A, B	A, B, C	A, B, C	A	A, B, C	B	B, C	A	B, C	B, C
0.26	0.25	0.26	0.26	0.26	0.28	0.26	0.25	0.28	0.26	0.25	0.25
Shadow mask	Aperture grille	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Aperture grille	Shadow mask	Shadow mask	Aperture grille	Shadow mask
1600 × 1280	1600 × 1200	1600 × 1280	1600 × 1280	1600 × 1200	1280 × 1024	1600 × 1280	1280 × 1024	1600 × 1280	1600 × 1200	1600 × 1200	1600 × 1200
24/86	30/92	30/85	30/107	30/107	28/70	35/85	30/70	30/80	30/85	30/86	30/82
50/150	50/160	50/120	50/152	50/152	50/120	50/120	50/120	56/120	50/120	50/152	50/130
144	180	135	100	150	100	135	100	130	135	135	135
✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✓				✓		✓	✓
8/20	4/26	4/13	4/16	4/16	13/6	8/32	18/8	25/8	10/4	11/10	8/12
66.7	66.7	80	Depends on video card	Depends on video card	75	100	67	66	75	150	152
76.8	75	74.5	Depends on video card	Depends on video card	75	75	75	75	N/A	131	125
100	113	75	75	75	85	75	70	76	70	105	105
75	75	75	Depends on video card	Depends on video card	N/A	75	85	75	N/A	94	90
80	85	75	75	75	60	76	60	75	75	80	75
60	73	67	75	75	N/A	66	N/A	60	65	70	65
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
									✓	✓	✓
✓	✓							✓		✓	✓
						✓			✓	✓	✓
✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
✓	✓	✓		✓	✓	✓	✓		✓	✓	✓
✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
					✓						
100–240	100–120	110–240	87–132/ 175–264	87–132/ 175–264	100–240	98–264	90–264	90–264	INP	120–240	120–240
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17.4 × 16.5 × 17.4 × 44.5	16.3 × 16.1 × 18.4 × 46.2	16.3 × 16.8 × 17.4 × 44	18.5 × 19.6 × 20 × 74	18.5 × 19.6 × 20 × 74	17.3 × 16.2 × 18.1 × 42	17.1 × 18.3 × 17.4 × 41	16.7 × 16.1 × 18.3 × 42.9	19.4 × 19.8 × 20.6 × 75.9	17.1 × 18.3 × 16.9 × 38	16.1 × 16.1 × 16.7 × 47	16 × 16.1 × 16.7 × 47
B	B	B	B	B	B	B	B	B	B	A	A
	✓	Optional			✓				✓	✓	
3/P, L	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	2/P, L, R	3/P, L, F	3/P, L, F
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(800) 329-8351	(800) 800-5202	(800) 426-7651	N/A	N/A	N/A	(800) 243-0000	(800) 827-3998	(800) 827-3998	N/A	(800) 843-2515	(800) 843-2515
http://www.daytek.com/	http://www.eizo.co.jp/welcome/	N/A	http://www.hitachi.com/	http://www.hitachi.com/	http://www.kdsusa.com/	http://www.lgeus.com/	http://www.maginnovision.com/	http://www.maginnovision.com/	http://www.maxgroup.com	http://www.mitsubishi-display.com/	http://www.mitsubishi-display.com/
1074	**1075**	**1076**	**1077**	**1078**	**1079**	**1080**	**1081**	**1082**	**1083**	**1084**	**1085**

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MONITORS FEATURES

	NEC Technologies MultiSync P1150	Nokia Display Products Multigraph 445Xi	Nokia Display Products Multigraph 447Xi	NSA/ Hitachi SuperScan Elite 611	NSA/ Hitachi SuperScan Elite 802 BYTE BEST	Panasonic Computer Peripheral Co. PanaSync S21	Panasonic Computer Peripheral Co. PanaSync/Pro P17	Princeton Graphics EO17
Price as tested (MSRP)	$2079	$1899	$899	$799	$1899	$1799	$899	$669
Nominal size (inches, diagonal)	21	21	17	17	20	21	17	17
Overall rating	8.9	8.4	8.6	8.0	9.0	8.7	8.1	7.6
Performance score (display quality)	9.4	8.7	9.0	8.2	9.6	8.9	8.2	7.9
Features score	8.4	7.6	7.6	7.6	7.6	7.6	7.6	7.5
Usability score	7.2	7.7	9.0	7.1	8.7	9.4	8.3	7.8
Power-economy score	9.2	7.0	7.6	4.4	7.2	5.8	4.9	5.1
CRT SPECIFICATIONS								
Viewable size (inches, diagonal)	19.6	19.7	15.7	16.0	20.0	18.7	14.8	16.2
Screen surface (A=antiglare; B=antistatic; C=antireflective)	A, B, C	A, B, C	A, B, C	A, B, C	A, B, C	A, B, C	A, B, C	A
Dot/grille pitch (mm)	0.28	0.26	0.25	0.26	0.26	0.25	0.25	0.26
Dot-mask type	Aperture grille	Shadow mask	Aperture grille	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask
Max. noninterlaced horizontal × vertical resolution (pixels)	1600 × 1200	1600 × 1200	1600 × 1200	1600 × 1200	1600 × 1280	1600 × 1280	1600 × 1280	1280 × 1024
SYNC-INPUT SIGNALS								
Min./max. horizontal scanning frequency (kHz)	31/94	30/102	31/92	31/92	31/100	30/95	30/86	30/70
Min./max. vertical scanning frequency (Hz)	55/160	50/150	50/150	50/120	50/160	50/160	50/160	50/120
VIDEO-INPUT SIGNAL								
Video bandwidth (MHz)	202	200	140	155	200	160	135	100
Separate RGB, 0.7-V p-p	✔	✔	✔	✔	✔	✔	✔	✔
Input connector (15-pin D-sub)	✔	✔	✔	✔	✔	✔	✔	✔
Input connectors (BNC–RGB, HD, VD)	✔					✔	✔	
DISPLAY MODE								
Number of factory-preset modes/ user-settable modes	21/22	14/18	10/22	7/13	6/20	8/13	8/13	13/8
640 x 480 Mac II mode (max. noninterlaced vertical-refresh rate, Hz)	160	N/A	N/A	N/A	160	160	160	67
832 x 624 Mac 16-inch mode (max. noninterlaced vertical-refresh rate, Hz)	141	N/A	75	N/A	144	141	129	75
1024 x 768 mode (max. noninterlaced vertical-refresh rate, Hz)	117	85	85	113	N/A	116	106	85
1152 x 870 Mac II two-page mode (max. noninterlaced vertical-refresh rate, Hz)	103	75	75	N/A	104	104	94	75
1280 x 1024 mode (max. noninterlaced vertical-refresh rate, Hz)	88	85	65	85	114	89	81	66
1600 x 1200 mode (max. noninterlaced vertical-refresh rate, Hz)	75	75	N/A	73	75	72	65	N/A
CONTROLS								
Degauss	✔	✔	✔	✔	✔	✔	✔	✔
Focus	✔							
Convergence	✔	✔	✔					
Signal level	✔			✔	✔	✔	✔	
Side convergence (pincushioning)	✔	✔	✔	✔	✔	✔	✔	✔
On-screen monitor settings	✔	✔	✔	✔	✔	✔	✔	✔
Color matching	✔	✔	✔	✔	✔	✔	✔	✔
PHYSICAL CHARACTERISTICS								
Integrated speakers								
Power input (volts AC)	110	110–240	110–220	120–240	120–240	100–240	100–240	110–240
VESA DPMS–compliant	✔	✔	✔	✔	✔	✔	✔	✔
Height × width × depth (inches) × weight (lbs.)	20.4 × 20.8 × 22.1 × 77.2	20.4 × 20.2 × 19.6 × 71	17.2 × 16.9 × 18.8 × 48.5	16.9 × 16.1 × 18.3 × 48.5	18.7 × 19.2 × 21 × 73	19.8 × 19.1 × 20.4 × 62.7	16.4 × 16.1 × 17.5 × 38.5	16.7 × 16.2 × 17.9 × 41
FCC rating	B	B	B	B	B	B	B	B
TCO-compliant	✔	✔	✔	✔	✔	✔	✔	
CUSTOMER SUPPORT								
Warranty length (years)/coverage	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R
Phone	(508) 264-8000	(415) 331-4244	(415) 331-4244	(617) 461-8300 x1305	(617) 461-8300 x1305	(201) 392-4812	(201) 392-4812	(714) 751-8405
Toll-free phone	(800) 632-4636	(800) 296-6542	(800) 296-6542	(800) 672-4685	(800) 672-4685	(800) 742-8086	(800) 742-8086	(800) 747-6249
Web address	http://www.nec.com/	http://www.nokia-americas.com/	http://www.nokia-americas.com/	http://NSA.Hitachi.com/	http://NSA.Hitachi.com/	http://www.panasonic.com/	http://www.panasonic.com/	http://www.prgr.com/
Inquiry Number	**1086**	**1090**	**1091**	**1088**	**1089**	**1092**	**1093**	**1094**

BYTE BEST = BYTE Best. ✔ = yes; N/A = not applicable; INP = information not provided.

Warranty: P = parts; L = labor; F = freight to repair center; R = return to customer.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

continued on page 115

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MONITORS FEATURES

	Princeton Graphics EO75	Samsung Electronics America 17GLsi	Sceptre Technologies, Inc. J73S	Sceptre Technologies, Inc. P73A	Smile International, Inc. CA1706M2	Sony Corp. of America Multiscan 17se II	Sony Corp. of America Multiscan 20se II	ViewSonic Corp. G810	ViewSonic Corp. P815
Price as tested (MSRP)	$799	$1049	$759	$795	$745	$1099	$1999	$1595	$2195
Nominal size (inches, diagonal)	17	17	17	17	17	17	20	21	21
Overall rating	8.2	8.1	8.1	8.3	8.0	8.2	8.5	8.6	8.9
Performance score (display quality)	8.3	8.3	8.5	8.6	8.0	8.6	8.9	8.7	9.3
Features score	7.6	7.6	6.0	6.6	6.6	7.3	7.3	7.3	7.3
Usability score	7.6	9.0	8.4	9.0	9.2	8.3	8.5	9.4	9.5
Power-economy score	4.6	5.1	5.1	4.6	4.8	6.7	6.7	6.2	6.0
CRT SPECIFICATIONS									
Viewable size (inches, diagonal)	16.2	15.7	15.7	15.7	16.0	16.0	19.0	20.0	20.0
Screen surface (A=antiglare; B=antistatic; C=antireflective)	A, B, C	B, C	A, B	A, B	B, C	A	A	A, B, C	A, B, C
Dot/grille pitch (mm)	0.26	0.26	0.28	0.26	0.26	0.25	0.25	0.25	0.25
Dot-mask type	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Aperture grille	Aperture grille	Shadow mask	Shadow mask
Max. noninterlaced horizontal vertical resolution (pixels)	1600×1200	1600×1200	1280×1024	1280×1024	1600×1280	1024×768	1024×768	1600×1280	1800×1440
SYNC-INPUT SIGNALS									
Min./max. horizontal scanning frequency (kHz)	30/95	30/85	31/69	30/70	30/82	32/82	32/96	30/89	30/115
Min./max. vertical scanning frequency (Hz)	50/120	50/120	50/90	50/110	50/120	50/120	50/160	50/160	50/160
VIDEO-INPUT SIGNAL									
Video bandwidth (MHz)	200	135	110	100	130	INP	INP	154	250
Separate RGB, 0.7-V p-p	✔	✔	✔	✔	✔	✔	✔	✔	✔
Input connector (15-pin D-sub)	✔	✔	✔	✔	✔	✔	✔	✔	✔
Input connectors (BNC- RGB, HD, VD)	✔	✔			✔	✔	✔		
DISPLAY MODE									
Number of factory-preset modes/ user-settable modes	15/8	12/11	12/16	8/12	33/33	10/10	10/10	8/7	8/7
640 x 480 Mac II mode (max. non-interlaced vertical-refresh rate, Hz)	67	120	N/A	N/A	75	150	160	67	67
832 x 624 Mac 16-inch mode (max. noninterlaced vertical-refresh rate, Hz)	75	120	N/A	N/A	75	127	141	75	75
1024 x 768 mode (max. noninterlaced vertical-refresh rate, Hz)	85	100	80	80	90	105	116	116	139
1152 x 870 Mac II two-page mode (max. noninterlaced vertical-refresh rate, Hz)	75	75	70	70	75	92	103	75	75
1280 x 1024 mode (max. noninterlaced vertical-refresh rate, Hz)	85	80	60	60	72	79	88	88	106
1600 x 1200 mode (max. noninterlaced vertical-refresh rate, Hz)	75	68	N/A	N/A	60	66	75	71	87
CONTROLS									
Degauss	✔	✔	✔	✔	✔	✔	✔	✔	✔
Focus									
Convergence						✔	✔		
Signal level								✔	✔
Side convergence (pincushioning)	✔	✔	✔	✔	✔	✔	✔		
On-screen monitor settings	✔	✔	✔	✔		✔	✔	✔	✔
Color matching	✔	✔		✔		✔	✔	✔	✔
PHYSICAL CHARACTERISTICS									
Integrated speakers		✔	✔						
Power input (volts AC)	100–240	90–132	100–250	100–250	90–260	110	110	90–264	90–264
VESA DPMS–compliant	✔	✔	✔	✔	✔	✔	✔	✔	✔
Height × width × depth (inches) × weight (lbs.)	16.7×16.2×17.9×41	17.1×16.6×17×46.2	15.8×16.2×17.7×40	16.6×16.1×17.1×37	16×16.4×16.4×41.8	16.3×15.9×17.7×49.6	19.5×18.6×19.7×66.1	19.2×19.9×20.4×60.6	19.2×19.9×20.4×60.6
FCC rating	B	B	B	B	B	B	B	B	B
TCO-compliant		✔	✔	✔		✔	✔		✔
CUSTOMER SUPPORT									
Warranty length (years)/coverage	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L, R	3/P, L	3/P, L	3/P, L, R	3/P, L, R
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BYTE BEST = BYTE Best.

✔ = yes; N/A = not applicable;
INP = information not provided.

Warranty: P = parts; L = labor;
F = freight to repair center; R = return to customer.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good
★★ Fair ★ Poor

Creating a Web page or site is an involved process. It's easier with the help of software like the packages we test here.

By Tadesse W. Giorgis

8 Tools for Weaving Your Web Site

Free at last! The World Wide Web's hyperlinked pages have freed us from moving through documents page-by-page. We jump at will from one section or document to another without losing the navigational links. To be accessible, however, a Web page must first exist as a Hypertext Markup Language (HTML) file on a Web server. The need to create and manage these files has spawned an entire new service industry, and an explosion of software tools makes it possible for nearly anyone with an Internet connection to create their own Web pages.

For this report, NSTL looked at eight Web-authoring programs for Windows 95/NT that facilitate creating Web pages for users with minimal HTML programming expertise. We also looked at three conversion/production tools and one new entry (see the text box "Four More for the Web" on page 118). At the low end are simple HTML editors with some provision for testing pages, such as a built-in previewer. At the high end are multifunction programs with WYSIWYG and graphics editors, site management capabilities, and a full-featured browser.

Of these dozen packages, we think you should first consider Microsoft's FrontPage 97 with its Bonus Pack. This powerful Web authoring, publishing, and site management product was the most versatile overall and among the easiest to use. In particular, Web-site designers will find the Microsoft Image Composer add-on extremely useful. FrontPage 97's site management and administration features make it highly attractive to companies planning a strong Internet presence or extensive intranet service.

However, if you want to build a site for personal use, or a small- to medium-size site, consider AOLpress, which is freely downloadable from America Online. Its interface is well done and easy to use, and it offers competent Web authoring and site management capabilities for a good price.

Web Pages Are Different

Web-page authoring and editing call for both content and creativity. Design is important, and visual design for the Internet requires a different approach than for print. The best packages provide professionally designed samples, templates, and style sheets, along with HTML guides, conversion tools, and reference resources to help you produce good-looking pages.

BYTE BEST

WEB-AUTHORING TOOLS

Microsoft FrontPage 97

is a powerful Web authoring, publishing, and site management product. Its site management and administration features are attractive to companies planning a strong Internet presence or an extensive intranet. It's the best product for high-end Web production and site management applications.

Depending on its content and complexity, a page may require programming to develop Java applets, ActiveX controls, Common Gateway Interface (CGI) scripts, server-side scripting, and database access.

Another important point involves the validity of HTML tags, references, and uniform resource locators (URLs). Bad or broken links mean a page won't do what its author intends (see the Tech Focus "Are Those Tags and URLs OK?" on page 120).

Siting the Pages

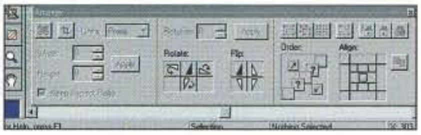
You must transfer new pages to a Web server using an FTP utility. This protocol ensures that directory and file structures and names are correctly mapped over the TCP/IP network. At this point, you must also consider security and access-control issues. Some authoring tools, such as FrontPage 97, have built-in security features that a Web author must understand to use effectively.

Putting together and administering a site might seem alien to a Web-page author, but once you get beyond a few pages, it's important to consider them in context, not as stand-alone pages. The best Web-authoring tools come with built-in site-administration and database-connectivity tools.

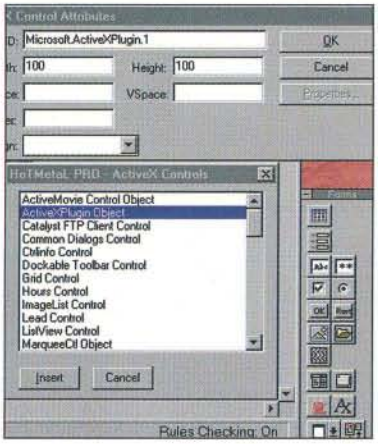
What Kind of Tool Am I?

What makes one Web-authoring package superior to others? In our tests, users favored flexible and versatile products that let them create lively, engaging, interactive, and dynamic pages. Some of the editors we tested—AOLpress, Emissary Desktop, FrontPage 97, HoTMetaL Pro, and Web Factory Pro Image—provide a WYSIWYG interface or something similar. Others, such as Aardvark Pro and HTML Builder, simply assist the author by plugging in the desired HTML tags

HoTMetaL Pro's graphical window, showing dialog boxes for inserted ActiveX controls.

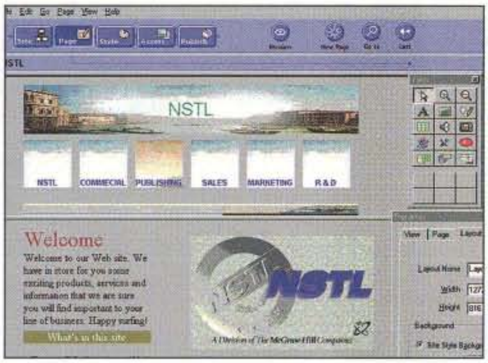


In addition to its Web-page creation capabilities, FrontPage 97 offers a wealth of site management tools, in a variety of formats, including a directory tree and a graphical site map.

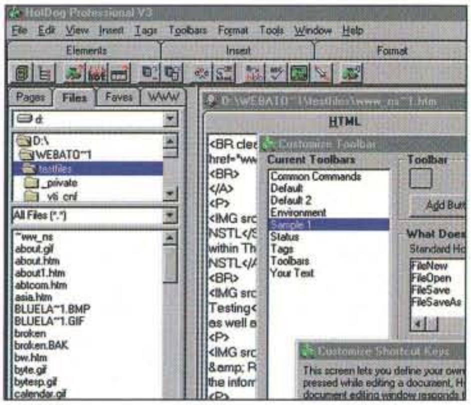

Control Attributes
ID: Microsoft.ActiveXPlugin.1
Width: 100
Height: 100
VSpace:

HoTMetaL PRO - ActiveX Controls
ActiveMovie Control Object
ActiveXPlugin Object
Catalyst FTP Client Control
Common Dialogs Control
CtlInfo Control
Dockable Toolbar Control
Grid Control
Hours Control
ImageList Control
Lead Control
ListView Control
MarqueeCtl Object

Rules Checking: On

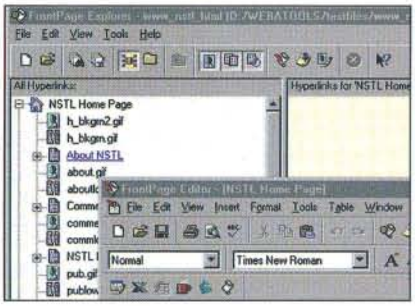


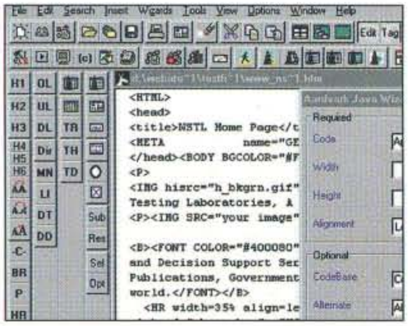
NetObjects' Fusion gives the Web author a powerful (if slow) new approach, with its PageMaker-like tool palettes and style/dialog boxes.



The highly customizable HotDog Professional shows off some of its capabilities. The two tabs at the rear, labeled HTML and Rover (the limited viewer/browser included with the package), are the main Web-page editing windows.

The graphics editor included with FrontPage 97 does a particularly good job of presenting graphics-manipulation options in a simple and understandable format.

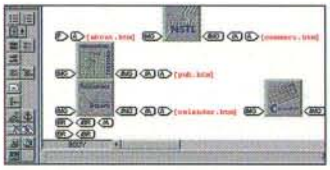

FrontPage Explorer
File Edit View Tools Help
All Hyperlinks:
Hyperlinks for 'NSTL Home
NSTL Home Page
h_bkgrn2.gif
h_bkgrn.gif
About NSTL
about.gif
FrontPage Editor - [NSTL Home Page]
File Edit View Insert Format Tools Table Window
Normal
Times New Roman


```
<HTML>
<head>
<title>NSTL Home Page</t
<META          name="GE
</head><BODY BGCOLOR="#F
<P>
<IMG hisrc="h_bkgrn.gif"
Testing Laboratories, A
<P><IMG SRC="your image"

<B><FONT COLOR="#400080"
and Decision Support Ser
Publications, Government
world.</FONT></B>
 <HR width=35% align=le
```

Aardvark Pro shows a typical text-editing window, but it's enhanced with a special wizard that simplifies the inclusion of Java applets into the page.

HoTMetaL Pro's graphical/iconic handling of HTML tags is unique. While it's arguably easier than straight text, it's no substitute for page previewing, which is another option, or graphics editing.



Everyone is making Web pages these days, and with authoring packages like these, it's much easier than it was just a year ago.

from a menu. These tag editors are fast and surprisingly useful. The WYSIWYG programs are sometimes limited, may lack the newest HTML features, need more system resources, and run slower.

WYSIWYG editors with a built-in previewer give a good idea of what the page will look like with a browser. HTML tag editors normally don't give feedback, relying instead on external Web browsers. Some editors, including HoTMetaL Pro and HotDog Professional, offer a compromise between the two approaches.

Although most users prefer a WYSIWYG editor, your choice should depend on what the package will let you do rather than how it does it. Ease of use matters, but it's not as important as page-construction potential. The better tool isn't always the easiest one to use.

Aardvark Pro

This intriguing package is, unfortunately, hard to recommend. It's a true HTML tag editor, providing efficient and cost-effective Web-page editing without needing extensive resources. While it's basically a single-function package, Aardvark Pro has extensive editing tools and utilities, including Color Chooser and Tags Chooser, which let you point and click on a text color or scheme or insert a paired HTML tag. The built-in previewer is convenient for checking the look of a Web page. Aardvark Pro has wizards for creating a home page, tables, forms, and Java applets.

But Aardvark Pro scored lowest for both ease of learning and use. It offers no HTML syntax checking, and it scored lowest on validation/error checking.

AOLpress

America Online's AOLpress offers excellent WYSIWYG editing and good documentation and support. It's easy to learn and use. It includes the MinWeb site management tool and a handy HTML syntax parser. Because AOLpress is freely down-

WEB-PAGE AUTHORING TOOLS RATINGS

BEST OVERALL

Microsoft FrontPage 97

Serious tools for site management and administration make this a versatile program.

	PRICE	TECHNOLOGY	IMPLEMENTATION	EASE OF LEARNING	EASE OF USE	VALIDATION/ ERROR CHECKING	OVERALL RATING
Microsoft FrontPage 97	**$149**	★★★★	★★★★★	★★★★	★★★★	★★★	★★★★★
FBS Aardvark Pro 2.2	$59	★	★	★★	★★	★	★
AOL AOLpress 1.2	Free	★★★	★★★	★★★★	★★★	★★	★★★
Attachmate Emissary Desktop 2.0	$99	★★	★★★★	★★★★	★★★★	★★	★★★★
Sausage Software HotDog Professional	$100	★★	★★★	★★★	★★★	★★	★★
SoftQuad HoTMetaL Pro 3.0	$159	★★★	★★★	★★★	★★★	★★★	★★★★
FLFSoft HTML Builder 1.1	$29	★	★★	★★★	★★★	★	★
TLC Web Factory Pro Image1.1	$229	★★	★★★	★★★	★★★	★★★	★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

loadable, it's the most cost-effective package here. However, it's slower than other packages. Also, it has no graphics-editing capability and was prone to lock up on unsupported tags.

Still, for small businesses and individuals who want to establish a presence on the Internet, AOLpress is an attractive prospect. We recommend it for small- to medium-size site applications.

Emissary Desktop

Attachmate's Emissary Desktop includes just about everything you'll need to create a Web page. It's also among the easiest to learn and use. Available in LAN and dial-up versions, Emissary Desktop combines Internet mail and news, Web browsing, host access, file management, and task scheduling. It features WYSIWYG editing and an easy-to-use, customizable interface.

On the downside, its HTML editing and syntax checking are limited, and there's no graphics editing. Still, more than any other product tested, Emissary Desktop offers a complete Web-building package.

FrontPage 97

When Microsoft bought FrontPage 97 from Vermeer, it picked a winner. In our tests, FrontPage 97 was the clear front-runner, excelling in versatility, graphics editing, and site management. It outscored the others in ease of use and learning and versatility. It came in second in validation/error checking.

FrontPage 97 is the most versatile of this group. It includes database access, Image Composer, Internet Explorer 3.0, the personal Web server, browser/previewer, spelling checker, thesaurus, and security and scripting support. FrontPage 97 corrects most syntax errors, such as unpaired tags, during file import, but not when you enter tags manually. The package needs an explicit HTML syntax-checking tool.

For the beginning Web author, FrontPage 97 isn't as straightforward as other WYSIWYG editors until you get used to its Explorer-dominated interface, which is less intuitive than it might be. Also, the menu structures were sometimes illogically different between modules.

HotDog Professional

Can you take seriously a program named HotDog Professional from a company called Sausage Software? Yes. This HTML editor has extensive tools and helper util-

Four More for the Web

SkiSoft's Web Publisher 1.1 accepts word processing, HTML, or FrameMaker documents that can contain images, tables, and OLE objects. It will automatically convert any image into GIF, build Netscape tables, create tables of contents with links to headings, interpret word-processing-style information, convert numbered and bulleted lists, and place signatures, mail-to uniform resource locators (URLs), and corporate in-line images in documents. Web Publisher will also convert multiple documents in a single pass.

Quadralay's WebWorks Publisher and Harlequin's WebMaker 2.2 take FrameMaker documents and convert them into HTML. These tools let you design and maintain, in a single master, a complete documentation base that can produce both high-quality print media and electronic hypermedia tailored to Web distribution, including on-line help systems. HTML output from FrameMaker documents retains all the generated cross-document and hypertext links, table of contents, and index navigation markers of the original.

Both WebWorks Publisher and WebMaker give you broad creative freedom to design layout styles. You can apply styles automatically with the click of a button. Both products take full advantage of FrameMaker's layout styles and let you define specialized layouts for Web publishing.

Fusion 1.0, from NetObjects, is an object-oriented authoring tool that integrates six components: SiteStructure, which creates a hierarchical map for designing and editing a site; PageDraw, a WYSIWYG page editor; SiteStyles Manager, a style-sheet editor; AutoSites, a library of dozens of professional designs; an asset manager, for referencing content objects and connecting to external databases; and a publishing engine, which gathers content and pages and converts them into complete Web sites.

Though our testers found Fusion a gem among authoring tools, it was very slow in staging and publishing Web pages before previewing. Designing the preview process a little more creatively would eliminate the problem. Fusion runs under Windows 95 and NT, and a Mac version should now be out.

FEATURES

	Aardvark Pro 2.2	AOLpress 1.2	Emissary Desktop 2.0	FrontPage 97	HotDog Professional	HoTMetaL Pro 3.0	HTML Builder 1.1	Web Factory Pro Image 1.1
CPU, OS, MEMORY REQUIREMENTS								
Minimum CPU	386	486	486	486	486	486/33	386	386
Windows 3.1/3.11	✓	✓				✓		✓
Windows 95/NT	✓	✓	✓	✓	✓	✓	✓	✓
Mac OS 7.x		✓						
SunOS, IRIX		✓		SE				
Solaris, HP/UX		✓		SE		✓		
AIX, BSD				SE				
RAM (MB)	8 (4 for Win 3.1)	16 (12 for Win 95)	16	8 (16 for Win NT)	16	8	8	8
Disk space (MB)	2	1	55	15	1	2	2	5
MAJOR COMPONENTS								
WYSIWYG editor		✓	✓	✓		✓		✓
Full-function Web browser	✓	✓	✓	✓				
Built-in HTML previewer	✓	✓	✓	✓	✓	✓		✓
Web-publisher utility	✓	✓	✓	✓	✓	✓		
Site management utility		✓	✓	✓				
Web-page templates	✓			✓	✓	✓	✓	
Task management utility		✓		✓		✓		
FILE MANAGEMENT								
Built-in file manager	✓	✓	✓	✓	✓	✓	✓	
Supports drag and drop			✓					✓
Organize document files into projects	✓							
Specify directory, browsers	✓		✓	✓	✓	✓	✓	
Specify external viewers/browsers		✓	✓	✓	✓	✓	✓	✓
Save document as text file	✓	✓	✓	✓	✓	✓	✓	
Import image file, single format	✓	✓	✓	✓		✓		✓
Import image file, multiple formats	✓		✓	✓		✓		
Full-location browsing,		✓		✓		✓		✓
Program includes wizards	✓		✓	✓	✓		✓	
File transfer utility (e.g., FTP)		✓	✓	✓	✓	✓		
HTML AUTHORING AND EDITING								
Java applet	✓	✓	✓	✓	✓	✓	✓	
ActiveX control				✓		✓		
Marquee	✓			✓	✓	✓		✓
Mail-to link		✓	✓	✓	✓	✓	✓	✓
Macro-language processor	Limited			✓		✓		
Parses in a single pass		✓	✓	✓	✓	✓	✓	
Checks for correctly formed URLs			✓	✓				✓
Checks link integrity when files are moved			✓	✓				✓
Auto-corrects unmatched tags								✓
GRAPHICS EDITING/MANIPULATION								
Full-function graphics editor, scanning module	✓		✓	✓	✓	✓		
Import graphics from multiple file formats	✓		✓	✓		✓		
Auto-conversion to GIF or JPEG	✓		✓	✓	✓	✓		
Full control of image size	✓		✓	✓	✓	✓		
DISPLAY, VIEWING, PREVIEWING								
Open multiple editing windows	✓	✓	✓		✓	✓	✓	✓
Open multiple preview windows		✓						✓
Edit and preview in same or separate windows	✓	Separate only	✓	✓	✓	✓	✓	✓
SITE MANAGEMENT								
Structural or folder/file view of map		✓	✓	✓				
Show all internal and external links		✓	✓	✓				
Show broken links graphically		✓		✓				
Expand or collapse view		✓		✓				
Move pages from one site to another		✓	✓	✓				
Add/delete/move pages to a site map		✓	✓	✓				
Can publish entire site or just pages		✓	✓	✓	✓	✓		

✓=yes SE=Via special server extensions. [U]=via utilities.

ities, including ActiveX support, though it has no graphics editor. The user interface is improved over earlier versions, with customizable floating toolbars, shortcut keys, a mini Web browser/previewer, autosaving, drag and drop, and easy insertion of image and sound files.

HotDog Professional uses multiple user-specified browsers to preview a document, enabling effective cross-browser compatibility checking. The product is fast and responsive, with features that appeal to both novice users and veteran Web masters. Of the three HTML editors, HotDog Professional is the clear choice.

HoTMetaL Pro

HoTMetaL Pro is now a full-featured, powerful, and versatile program. It offers both HTML and WYSIWYG editing, an excellent graphics editor, and the best HTML checking, making it handy for Web masters who must test pages created by others. It excels at document conversion.

In HoTMetaL Pro, you don't see straight ASCII. Instead, Web-page elements are surrounded by semigraphical HTML tags, which you can hide.

We found HoTMetaL Pro occasionally unstable. What's more, its publishing capability is limited, and as an advanced Web-authoring program, it should have some site management capabilities.

HTML Builder

This simple, inexpensive, and efficient HTML editor is greatly improved over its earlier version. It's easy to set up and use, but functionality is limited.

The program opens with a lean interface that expands after you create a new file or load an existing one. You can enable or disable toolbar elements for styles, headings, links, special characters,and HTML 3.2 extensions. The starting template provides the basic HTML tags.

Web Factory Pro Image

A mixed bag, Web Factory Pro Image is easy to set up and use, with a flexible interface, and efficient and capable HTML syntax checking and validation. It opens paired HTML and preview windows for each Web page. You can edit in either window, and the corresponding action is reflected in the nonediting window whenever you make a change. But the product is unreasonably expensive, especially in view of its limited scope, and it doesn't even include a full browser. B

Tadesse W. Giorgis has tested network OSes, management products, and peripherals at NSTL for over five years. You can contact him at **tadesse@nstl.com.**

TECH FOCUS TESTING

Are Those Tags and URLs OK?

The strength of Web pages as a communications medium is their use of hyperlinks. What makes Web documents less than useless are broken or incorrect links. To avoid this, a variety of tools can help validate Hypertext Markup Language (HTML) documents by checking them for syntax errors and integrity of links. Most HTML editors include such functions, and tools are available on the Web to check documents against the latest HTML specifications (try http://www.webtechs.com/html-val-svc and http://www2.imagiware.com /RxHTML). For a tool that checks for links to nonexistent resources, such as pages that have moved, try http://wsk.eit.com/ wsk/dist/ doc/admin/webtest/verify_links.html.

It's important to test Web pages with several Web browsers to see that they look the way the Web author/designer intended and that all hyperlinks are valid. It can also be important to test with browsers on various platforms to eliminate any incompatibilities. For example, one early version of the BYTE Site (http://www.byte.com) looked fine on most browsers except for some Netscape versions on the Mac, where the colors became distorted and muddy.

PRODUCT INFORMATION

Aardvark Pro 2.2
$59
Functional Business Systems
Fairview Park, South Australia, Australia
fax: +61 8 8251 5648
http://www.tmgnet.com /aardvark/
Circle 1050 on Inquiry Card.

AOLpress 1.2
Free via download
America Online, Inc.
Vienna, VA
(800) 879-6882
fax: (703) 918-1106
http://www.aolpress.com
Circle 1051 on Inquiry Card.

Emissary Desktop 2.0
$49 (dial-up), $99 (LAN)
Attachmate, Inc.
Bellevue, WA
(800) 426-6283
(206) 644-4010
fax: (206) 747-9924
http://www.attachmate.com
Circle 1052 on Inquiry Card.

FrontPage 97
$149
Microsoft Corp.
Redmond, WA
(206) 882-8080
fax: (206) 936-7329
http://www.microsoft.com
Circle 1053 on Inquiry Card.

Fusion 1.0
$495
NetObjects, Inc.
Redwood City, CA
(415) 482-3200
fax: (415) 562-0288
http://www.netobjects.com/
Circle 1054 on Inquiry Card.

HotDog Professional
$99.95
Sausage Software, Inc.
Doncaster, Victoria, Australia
fax: +61 39 855 9800
http://www.sausage.com
Circle 1055 on Inquiry Card.

HoTMetaL Pro 3.0
$159
SoftQuad, Inc.
Toronto, Ontario, Canada
(800) 387-2777
(416) 544-9000
fax: (416) 544-0300
http://www.sq.com
Circle 1056 on Inquiry Card.

HTML Builder 1.1
$29
FLFSoft, Inc.
Oak Creek, WI
(414) 764-8666
http://www.execpc.com/~flfsoft
Circle 1057 on Inquiry Card.

Web Factory Pro Image 1.1
$229
Thunder & Lightning Co.
San Diego, CA
(619) 643-5550
fax: (619) 643-5553
http://www.tlco.com
Circle 1058 on Inquiry Card.

WebMaker 2.2
$99
Harlequin, Inc.
Cambridge, MA
(617) 374-2400
fax: (617) 252-6505
web@harlequin.com
http://webserver.harlequin.com/
Circle 1059 on Inquiry Card.

Web Publisher 1.1...$495
SkiSoft Publishing
Lexington, MA
(617) 863-1876
fax: (617) 861-0086
http://www.skisoft.com/
Circle 1060 on Inquiry Card.

WebWorks Publisher
$895
Quadralay Corp.
Austin, TX
(512) 719-3399
fax: (512) 719-3606
http://www.quadralay.com/
Circle 1061 on Inquiry Card.

Evaluations in this report represent the judgment of BYTE editors, based in part on extensive tests conducted by NSTL, Inc., as documented in a recent issue of its monthly Software Digest. *To purchase a copy of that report, with NSTL's own evaluations and data, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; on the Internet, editors@nstl.com. For a subscription, call (800) 257-9402. BYTE magazine and NSTL are both operating units of The McGraw-Hill Companies.*

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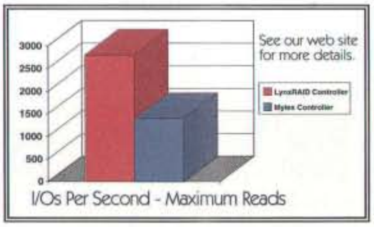

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Fax: +44 (0) 1253 353811
E-mail:info@pap.com
WWW: http://www.demon.co.uk/ar/TPAC

PADD97

The Practical Application of Knowledge Discovery and Data Mining

Vast amounts of data are being collected by organisations worldwide. PADD97 will show how KD & DM techniques are used to extract and transform hidden information into valuable knowledge through the discovery of relationships and patterns. PADD97 will demonstrate how this information can then be used for a wealth of business opportunities.

Keynote speakers & presenters so far include:
Usama Fayyad, Microsoft Research & Evangelos Simoudis, IBM ; Ken Totton & Huw Roberts, BT; Luc DeRaedt, University of Leuven and Stephen Muggleton, Oxford University.

PAAM97

The Practical Application of Intelligent Agents and Multi-Agent Technology

Multi-Agent technology is providing increasing benefit to business and industry. PAAM97 will deal with a number of key issues. How can agent technology solve problems faced today? What are the benefits, rewards, and return on investment? What developments are in the pipeline for tomorrow? What are the opportunities, and the pitfalls for software agents?

Keynote speakers & presenters so far include:
Patti Maes, MIT; Jeff Bradshaw, Boeing; Benjamin Grosof, IBM; Donald Steiner, Siemens; Toru Ishida, Kyoto University.

PAP97

The Practical Application of Prolog

PAP is the world's leading showcase for Prolog applications and systems. Now in its fifth year the conference continues to grow, and to demonstrate the benefits of this important technology. These include increased productivity, reduced maintenance, and flexible solutions which can easily adapt to changing business needs.

Keynote speakers & presenters so far include:
Peter Reintjes, NetSpeak; Phil Vasey, LPA, Manuel Hermenegildo, Polytechnic University of Madrid; John Fox, ICRF and Oskar Bartenstein, IF Computer.

~~PACT~~ 97

The Practical Application of Constraint Technology

PACT is the premier forum for constraint applications and systems. Now in its third year the conference builds on the success of PACT96, and will focus on the industrial exploitation of Constraint Programming, and explore the real world benefits for business, and future trends for this important technology.

Keynote speakers & presenters so far include:
Helmut Simonis, Cosytec; Henri Beringer, ILOG, and Claude Lepape, Bouygues.

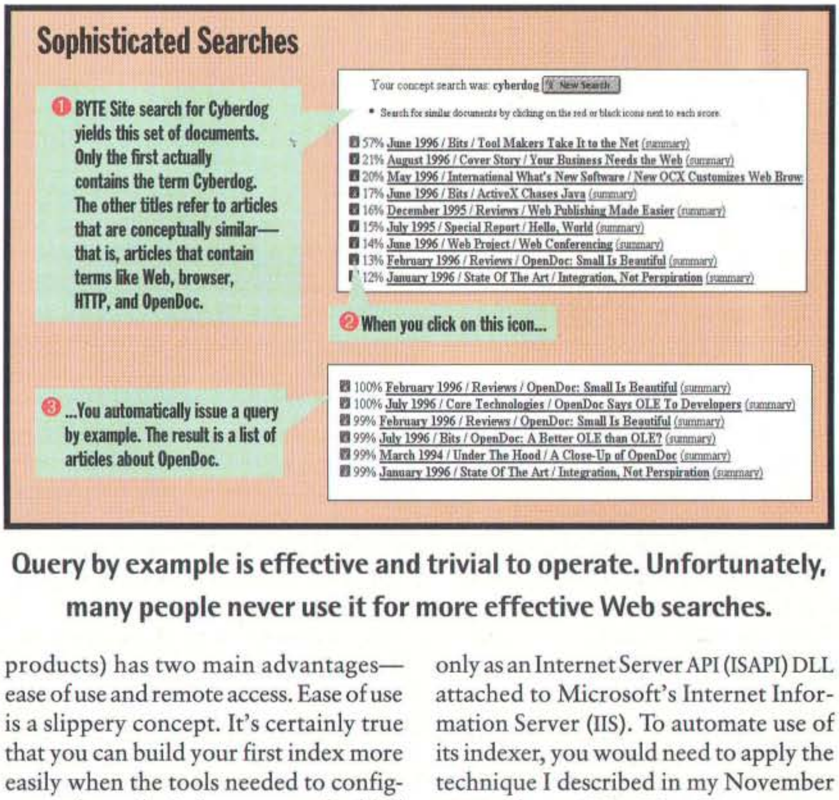
FAULT DIAGNOSIS CONFIGURATION

Jon Udell

Web Project

Search Again

Move beyond the basics to take advantage of query by example, concept searching, and field indexing.



Sophisticated Searches

❶ BYTE Site search for Cyberdog yields this set of documents. Only the first actually contains the term Cyberdog. The other titles refer to articles that are conceptually similar—that is, articles that contain terms like Web, browser, HTTP, and OpenDoc.

Your concept search was: **cyberdog** New Search

- Search for similar documents by clicking on the red or black icons next to each score.

57% June 1996 / Bits / Tool Makers Take It to the Net (summary)
21% August 1996 / Cover Story / Your Business Needs the Web (summary)
20% May 1996 / International What's New Software / New OCX Customizes Web Brow
17% June 1996 / Bits / ActiveX Chases Java (summary)
16% December 1995 / Reviews / Web Publishing Made Easier (summary)
15% July 1995 / Special Report / Hello, World (summary)
14% June 1996 / Web Project / Web Conferencing (summary)
13% February 1996 / Reviews / OpenDoc: Small Is Beautiful (summary)
12% January 1996 / State Of The Art / Integration, Not Perspiration (summary)

❷ When you click on this icon...

❸ ...You automatically issue a query by example. The result is a list of articles about OpenDoc.

100% February 1996 / Reviews / OpenDoc: Small Is Beautiful (summary)
100% July 1996 / Core Technologies / OpenDoc Says OLE To Developers (summary)
99% February 1996 / Reviews / OpenDoc: Small Is Beautiful (summary)
99% July 1996 / Bits / OpenDoc: A Better OLE than OLE? (summary)
99% March 1994 / Under The Hood / A Close-Up of OpenDoc (summary)
99% January 1996 / State Of The Art / Integration, Not Perspiration (summary)

Query by example is effective and trivial to operate. Unfortunately, many people never use it for more effective Web searches.

In my September 1995 column ("Web Search"), I showed how to add basic indexing and search functions to a Web site (see http://www.byte.com/art/9509/sec9/art1.htm). The freely available tools I discussed there—freeWAIS (Wide Area Information Service) and Simple Web Indexing System for Humans (SWISH)—have served the BYTE Site well and continue to support thousands of searches every day. However, the site's growth in size and complexity mandates a more sophisticated search capability than these basic tools can easily provide.

Therefore, I've been testing a number of indexing and search tools—Web Glimpse, Verity's TopicSearch, InMagic's DB/Text WebServer, Digital Equipment's AltaVista Private Extensions, Excite for Web Servers (EWS), and the Microsoft Index Server (MSIS). So far, I've added search functions to the public BYTE site using the latter two engines. Here's how.

Implementing EWS

Excite (formerly Architext) makes EWS freely available for several flavors of Unix and Windows NT; I'm running it on NT 3.51. At its core are two stand-alone programs—architextindex and architext search. You needn't touch them, though, because EWS comes with Perl wrappers for them (and a copy of Perl 5 to execute the wrappers). You needn't touch the Perl wrappers either, because they are in turn wrapped in a layer of Hypertext Markup Language (HTML) so that administration as well as use of EWS is Web-driven.

The Web-oriented administrative style of EWS and other second-generation tools (including the Verity and Microsoft products) has two main advantages—ease of use and remote access. Ease of use is a slippery concept. It's certainly true that you can build your first index more easily when the tools needed to configure and run the indexer are embedded in HTML forms that explain how to use the tools. However, this interactive mode becomes a hindrance when you move from prototyping to production: That's because a URL-driven (uniform resource locator) tool is far more difficult to integrate into scheduled and scripted batch processes than is a command-line-driven tool.

With EWS, you can bypass the Web interface and use the Perl wrappers or underlying programs directly. This method isn't documented, but at least it's available. Other implementations foreclose that option entirely. Verity's freeware version of TopicSearch, for example, runs only as an Internet Server API (ISAPI) DLL attached to Microsoft's Internet Information Server (IIS). To automate use of its indexer, you would need to apply the technique I described in my November 1996 column ("On-Line Componentware")—discover the URL-based API implicit in the Web interface and program to that API using a library that gives scripts the ability to "call" Common Gateway Interface (CGI) URLs.

Silly Claims

Considering all that utter rigmarole, the notion of just adding a command plus some arguments to your `/etc/crontab` file (or its NT equivalent) seems rather appealing. Also, the ease-of-use claim that some vendors make on behalf of their Web-integrated solutions can appear somewhat silly. Web-based control of indexers or other kinds of applications

PHOTOGRAPH: KELLIE WALSH © 1997

can be a useful adjunct to conventional methods, but it's not necessarily an appropriate replacement for them.

Advanced Indexing

If your site is even moderately complex, you probably won't want to just point an indexer at the Web server's root and let it rip. You'll likely have distinct subtrees that you want to index. Within those subtrees, you'll want to include some classes of files but not others. Some indexers (e.g., the Microsoft product) can't exclude files at all. If you want to restrict search results, you'll have to parse and filter them on the fly. That's doable, but it's complex and computationally expensive. If there are subdirectories and files you don't want people to find, it's best to leave them out of your index.

The first engine I implemented on the BYTE Site, freeWAIS, has only a weak exclusion mechanism. You can exclude wild-carded filenames but not wild-carded paths. Because I need to do the latter, my indexing scripts for freeWAIS are too verbose. They enumerate long lists of subtrees for inclusion, rather than short lists of subtrees to include along with short lists of patterns to exclude.

SWISH is more agile. I can use the rule PATHNAME CONTAINS IMG to exclude the dozens of directories in which I store the HTML wrappers for BYTE Site images. These wrappers, which would otherwise be included in the index, contain hardly any useful text and are best left out.

If you're somebody who needs additional flexibility, EWS's exclusion mechanism is even more agile. Unlike SWISH, EWS lets you describe excluded items not only with wild cards, but with full-blown regular expressions. Why would you need to do that?

Consider the BYTE Site's conferencing application I discussed in last month's column, "Dual-Mode Conferencing." It generates multiple versions of each message to support both frame-based and frameless viewing. However, you probably don't want to see two copies of each message in the search results list, so I decided to exclude the frame-based set. When I indexed the conferences with SWISH, I found that I couldn't differentiate between the two classes of files using simple wild cards. Fortunately, EWS's regular-expression capability solves this sort of problem neatly and quickly.

TOOLWATCH

Internet Music Kit
($49)
Wildcat Canyon Software
http://www.wildcat.com/

Embed MIDI files on your Web pages for streaming playback using a Netscape plug-in or an ActiveX control.

Best-Kept Secret

The odds are that if you've tried EWS on the BYTE Site or another of the sites where it runs, you've missed its best feature: query by example, or QBE (see the figure "Sophisticated Searches" on page 123). To try it for yourself, go to the BYTE Site and use EWS to search for Cyberdog. As you would expect, a list of clearly Web-related titles comes back.

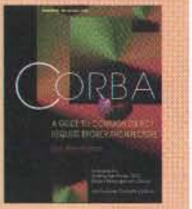
What you might not expect, though, is that if you have used the default concept search setting, most of these articles won't include the word *Cyberdog*. They will, however, contain sets of terms (e.g., *browser*, *HTTP*, and *OpenDoc*) that correlate statistically with the few articles that mention Cyberdog. If you're interested in how OpenDoc relates to Cyberdog, or if you hadn't even known that it did, you will appreciate EWS automatically making that connection for you. That's what EWS means by the notion of concept search—and it's not even the best feature that users often don't get.

Here's the best feature: Click on the red or black icon that introduces one of the documents in the Cyberdog result set whose title includes the term *OpenDoc*. This action says: "Find similar articles." The new result set will contain many more OpenDoc-related titles. If the example didn't contain Cyberdog, the new result set will have taken you on a quite different tack from the original query.

This refocusing mechanism can be incredibly useful when you're doing research. You naturally want to follow a branching path through conceptual space. After scanning a few of the articles in the OpenDoc result set, you might want to focus specifically on comparisons between OpenDoc and OLE.

If you click on the icon that goes with the likeliest candidate, EWS will return a third result set in which the OLE theme is more prominent. Every article on every search-results page is itself an implicit query—a single-click accessor of a set of related articles.

BOOKNOTE



CORBA
A Guide to the Common Object Request Broker Architecture
($45)
by Ron Ben-Natan
Computing McGraw-Hill
http://www.mcgraw-hill.com/

A useful guide to interface definition language, object services, and object database management.

Once you discover this principle, it transforms how you explore a document collection. You don't have to worry about forming exactly the right search expression. Just seed the process with words that get you conceptually near what you're looking for and let QBE automatically feed statistical profiles back into the searcher as you click your way through a series of refinements.

It's brilliant, it's effective, and it's trivial to operate, yet many users never discover QBE even though every search page says "Click on the red or black icons to search for similar articles." I know this because I hacked the Perl wrapper to log search terms. (I always do this because analyzing what people search for tells me a lot about what kinds of information we ought to be providing.) Fewer than 5 percent of the first several thousand EWS queries I logged were of the QBE flavor, and many of these were my own tests. Moreover, an informal poll of BYTE staffers showed that while many had encountered EWS in their travels on the Web, none of them had discovered QBE.

"It's a problem," agrees Graham Spencer, chief technology officer for Excite. "In academic information retrieval, the average search expression is 12 to 15 terms long; on the Web, it's 1.5 terms." EWS constructs those 15-term expressions for you automatically when you use QBE. That users often don't realize this is partly a failure of user-interface design—the icons could be bigger, the instructions more prominent. But it's also a failure of expectations. Web surfers accustomed to more

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*InformationWeek, July 29, 1996.

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conventional search technology just don't expect EWS to do what it does.

Microsoft Index Server

As nifty as EWS is, it lacks four desirable features: a high-performance architecture, phrase and proximity search, field indexing and searching, and automatic indexing on demand. MSIS, though weak in some areas, offers these four features. To try it, you have to join a fairly exclusive club. MSIS doesn't just require NT and IIS; it demands NT 4.0 and IIS 2.0.

You're not prepared to obsolete a stable NT 3.51 production server just for this purpose? Neither was I, so I ran MSIS on a development server, pointed it at an HTML collection on the production server, and tweaked the result URLs to refer to actual files on the production server instead of nonexistent ones on the test machine.

Both EWS and MSIS are running this way—as true distributed services off-loaded from the primary production server, linked to the site by means of URLs. It's easy to create this kind of distributed search capability with MSIS, because it automatically finds and offers to index any virtual directories mounted on IIS. If the MSIS/IIS machine and the document server live in the same NT domain, MSIS can index the remote document server.

There's one catch, though. IIS needs a user name and password to mount the virtual directory. After I supplied these credentials, browsers talking to IIS could read documents in and below that directory. But MSIS couldn't index them. Even though it runs as an ISAPI extension to IIS, it has its own notion of access credentials. I had to configure the IIS mount not just with a user name and password, but more specifically with a domain name\user name and password. Then it worked.

Implementing MSIS

For querying, MSIS uses the Internet Database Connector model again. In this scheme, an HTML form refers to a query-configuration (IDQ) file that names the index to search, enumerates which fields to return, and describes how to order those fields. The IDQ file also names an HTML template (HTX) file that will format the query results. To redirect the result URLs to the production server, I replaced occurrences of `<%server_name%>` in the HTX file with `www.byte.com`.

As with the Internet Database Connector, you can use other predefined variables with a simple IF ... THEN syntax to reformulate the result set (e.g., to chunk a long list of result URLs into a linked series of HTML pages). The HTX language is not powerful enough, however, to achieve the standard BYTE Site presentation of search results. I use Perl to capture document titles emitted by SWISH, parse out an issue-date field (e.g., February 1996), and sort in reverse chronological order.

Indexing and Search Tools

Benefit

In general, the tools make it easier to create first-time indexes of your site.

Problem

The tools can become a hindrance when you go from prototyping to production.

Advice

Don't expect to find an ultimate do-everything tool. Focus instead on tagging your data to organize search results in useful ways.

Products tested at the BYTE Site

WebGlimpse
Verity's TopicSearch
InMagic's DB/Text WebServer
Digital Equipment's Alta Vista Private Extensions
Excite for Web Servers
Microsoft Index Server

Several areas of the BYTE Site cry out for field indexing. In the Virtual Press Room, you should be able to do a field (rather than full-text) search for company and product names. In the conferences, similarly, you should be able to search author and subject fields. If you use meta tags to create fields in your HTML document headers, MSIS automatically uses them to create field indexes. For example, a VPR document header looks like this:

```
<html><head>
<meta name="company" content=
"SunSoft">
<meta name="product" content=
"Java Workshop">
```

When I indexed the VPR collection, MSIS constructed company and product indexes. To use them, I had to add this incantation to my IDQ file:

```
MetaCompany(DBTYPE
_STR) = d1b5d3f0-c0b3-11cf-9a92-
00a0c908dbf1 company
MetaProduct(DBTYPE
_STR) = d1b5d3f0-c0b3-11cf-9a92-
00a0c908dbf1 product
```

Then, I could issue the query

```
@MetaCompany SunSoft
```

to find all SunSoft press releases. What a great idea! Field indexing adds a new dimension to the full-text indexing so common on the Web. It's rarely done for two reasons: Indexers often don't support it, and document collections often don't provide fielded content. Leveraging meta tags as MSIS does is the right way to advance the cause of field indexing. Other engines, including Netscape's Catalog Server and the high-end version of Verity's TopicSearch, can also exploit meta tags.

Unfortunately, MSIS in its current form (version 1.1) can't read or manipulate the contents of these user-defined fields. So while you can search for SunSoft press releases, you can't write an HTX file that sorts the results by product name. And you can't even use the HTX file to print the values of the company and product fields.

The Ultimate Engine?

Basic though SWISH is, I continue to get a lot of mileage out of it. In my view, there's no perfect search engine. If you haven't indexed your site yet, don't get too hung up on choosing the ultimate do-everything tool. Focus instead on tagging your data in ways that let you organize search results in useful ways. Meta tags are a great way to instrument your content so that results returned from any search engine can be sorted by date or category. Once that's done, you can easily replace a basic search tool with a fancier one. B

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*Jon Udell (**judell@bix.com**) is BYTE's executive editor for new media.*

WHERE TO FIND

WebGlimpse
(http://donkey.cs.arizona.edu/webglimpse/)

Verity's TopicSearch
(http://www.verity.com/)

InMagic's DB/Text WebServer
(http://www.inmagic.com/)

Digital's AltaVista Private Extensions
(http://altavista.software.digital.com/)

Excite for Web Servers
(http://www.excite.com/)

Microsoft Index Server
(http://www.microsoft.com/internet/)

1997 Editors' Choice Awards

Thousands of products and technologies are announced each year, but few manage to fulfill the potential of their spec sheets. Yet every year, a select group of hardware and software delivers innovations that reset our expectations by allowing us to work in new ways.

Each year, we honor those top-tier products with the BYTE Editors' Choice Awards. Awards of Excellence showcase technical innovation that sets a new standard for a product class. Awards of Distinction single out products that are important from a technical, features, or price standpoint. Awards of Merit go to products worth noting for an interesting feature or price.

Our award winners represent a breadth of technologies, yet all the honorees have something in common: They all continue to make computing exciting.

Awards of Excellence

Adobe PrintGear

PostScript's younger cousin enables low-cost devices to deliver high-quality output. Adobe Systems, Mountain View, CA; (415) 961-4400; http://www.adobe.com.

Apple Cyberdog 1.1

Apple's Internet technology makes point-and-click integration of Web content practical. Apple Computer, Cupertino, CA; (408) 996-1010; http://www.apple.com.

Intergraph TD-410 with Intense 3D card

Combine a dual-Pentium Pro system and Intergraph's sophisticated 3-D accelerator and you get a performance leader in personal graphics workstations. Intergraph, Huntsville, AL; (205) 730-2000; http://www.intergraph.com.

Metrowerks CodeWarrior 10

A unified front end makes it easy to develop applications for Be, Palm Pilot, Magic Cap, Windows, and embedded applications. Metrowerks, Austin, TX; (512) 873-4700; http://www.metrowerks.com.

Microsoft Windows NT 4.0

The newest NT is faster than its predecessors, more agnostic about networks, and generous in the quality of Web services it delivers in the standard package. Microsoft, Redmond, WA; (206) 882-8080; http://www.microsoft.com.

Palm Pilot

A svelte PDA that's small enough to carry around easily and a docking station that makes data sharing with desktop PCs practical. U.S. Robotics (Palm Computing Division), Los Altos, CA; (415) 949-9560; http://www.usr.com/palm.

Proxima Desktop Projector 4100Z

A $10,000 presentation "appliance" that combines Texas Instruments' Digital Light Processor and Adobe's Acrobat. Proxima, San Diego, CA; (619) 457-5500; http://www.prxm.com.

Silicon Graphics O2 workstation

A clever unified memory architecture efficiently handles complex video and graphics; street prices start below $6000. Silicon Graphics, Mountain View, CA; (415) 960-1980; http://www.sgi.com.

Stratus Computer Radio PC

Fault-tolerant Pentium Pro that supports n-way clustering. Stratus Computer, Marlborough, MA; (508) 460-2000; http://www.stratus.com.

Tektronix Phaser 550

The first network peripheral we tested with a Web browser interface. This 1200-dpi color printer also distinguishes itself with a 14-page-per- minute monochrome output mode. Tektronix, Wilsonville, OR; (503) 682-7370; http://www.tek.com.

Wall Data Salsa 2.1

A visual database development tool with clever object-oriented technology. Wall Data, Kirkland, WA; (206) 814-9255; http://www.walldata.com.

Awards of Distinction

Adobe Photoshop 4.0

Image manipulation has never been easier thanks to more sophisticated layering capabilities. Adobe Systems, Mountain View, CA; (415) 961-4400; http://www.adobe.com.

Apple PowerMac 9500MP

The first PowerMac to finally bring multiprocessing to high-end applications. Apple Computer, Cupertino, CA; (408) 996-1010; http://www.apple.com.

Apple PowerBook 1400

Multimedia on the road doesn't get much better than this, thanks to the 1400's large display, CD-ROM drive, and easy expansion capabilities. Apple Computer, Cupertino, CA; (408) 996-1010; http://www.apple.com.

BeBox

Inexpensive hardware plus a multithreaded operating system provide a great platform for multimedia development. Be, Inc., Menlo Park, CA; (415) 462-4141; http://www.be.com.

Compaq Armada 4130T

Highly configurable Pentium notebook means we can finally build the portable we want to satisfy our individual needs. Compaq Computer, Houston, TX; (713) 514-0484; http://www.compaq.com.

Compaq ProLiant 5000

Best performance, best diagnostics among the first quad 200-MHz Pentium Pro systems we tested. Compaq Computer, Houston, TX; (713) 514-0484; http://www.compaq.com.

Digital Equipment FX!32

Brings fast Win32 emulation to NT-based Alpha machines. Digital Equipment Corp., Maynard, MA; (508) 493-5111; http://www.pc.digital.com.

Digital Equipment Corp. AltaVista Search Intranet Private Extension

Personal version of AltaVista engine for searching your PC or network files. Digital Equipment Corp., Maynard, MA; (508) 493-5111; http://www.pc.digital.com.

Digital Equipment Corp. and Advanced RISC Machines StrongArm processor

An innovative processor that gives PDAs the horsepower they need for handwriting recognition and other essential tasks. Digital Equipment, Maynard, MA; (508) 493-5111; http://www.pc.digital.com.

Digital Harbor WAV

A $49 word processor for PowerMacs uses OpenDoc components to let you create sophisticated publications with embedded images, diagrams, and charts. Digital Harbor, Lindon, UT; (801) 796-8213; http://www.dharbor.com.

IBM OpenDoc toolkit for Windows

A key piece in the puzzle to let independent applets interact across LANs and WANs. IBM, Armonk, NY; (914) 765-1900; http://www.ibm.com.

IBM ThinkPad 760 CD

A pioneer with a 12.1-inch color displays includes a fast Pentium processor, quad-speed CD-ROM drive, and MPEG-2 video playback. IBM, Armonk, NY; (914) 765-1900; http://www.ibm.com.

IBM ThinkPad 560

This easy-to-carry 4.1-pound package packs a riveting 12.1-inch color display. IBM, Armonk, NY; (914) 765-1900; http://www.ibm.com.

IBM OS/2 Warp 4.0

Combines an impressive mix of voice recognition, Java, and network management capabilities. IBM, Armonk, NY; (914) 765-1900; http://www.ibm.com.

Quarterdeck WebCompass

A metasearch tool for scouring multiple indices. Quarterdeck, Marina del Rey, CA; (310) 309-3700; http://www.quarterdeck.com.

Lotus Notes 4.0

New visual programming tools and Internet connections make this groupware leader a Web powerhouse. Lotus Development, Cambridge, MA; (617) 577-8500; http://www.lotus.com.

Lotus Domino

Helps Notes developers create dynamic Web sites. Lotus Development, Cambridge, MA; (617) 577-8500; http://www.lotus.com.

BYTE Hall of Fame

When BYTE announced its first editors' awards in 1989, the Internet community consisted mainly of scientists and educators, the World Wide Web was still three years from launching, and high-end desktop CPUs ran at a blazing 25-MHz. Today, our 1997 BYTE Awards winners reflect a new world of hardware, software, and communications.

The links between 1989 and today exist in the products below, all past BYTE Awards winners that introduced innovations to change the face of computing.

Adobe Acrobat

A lingua franca for electronic documents with easy text searching and hypertext links.

Adobe Photoshop

The leader in image editing for Macs and Windows PCs.

Apple System 7

The Mac OS was synonymous with GUIs, and System 7 continued the tradition with ease of use, true plug-and-play, and color matching.

Apple PowerBook Series

These notebooks define the standard for ergonomic mobile computing.

Apple PowerMac

Apple's well-planned and successful leap from CISC to RISC. The new Macs ran existing 680x0-based applications with PowerPC performance, and Apple sold more than a million systems in the first year.

Apple QuickTime

The technology that helped turn audio and video into common data types.

Digital Equipment Alpha

A 64-bit RISC processor that made its debut at 200 MHz

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Windows 95 for Busy People
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LAN Times Encyclopedia of Networking
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C Complete Reference
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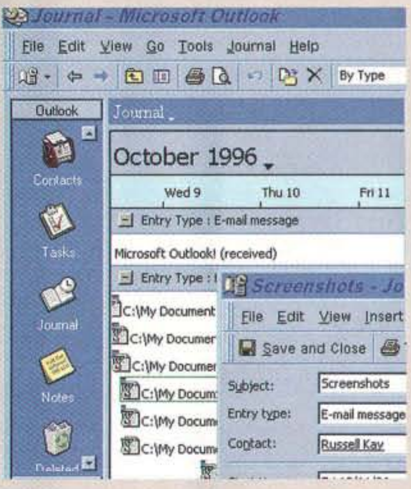
MarketScape WebCD 1.0
The easy way to create a Web site image on a CD-ROM for data dissemination and presentations. MarketScape, Colorado Springs, CO; (719) 593-9890; http://www.marketscape.com.

Microsoft's File and Print Services for NetWare
Makes NT servers work like NetWare 3.12 file and print servers. Microsoft, Redmond, WA; (206) 882-8080; http://www.microsoft.com.

Microsoft Internet Explorer 3.0
The first Microsoft browser with envelope-pushing technology. Microsoft, Redmond, WA; (206) 882-8080; http://www.microsoft.com.

Microsoft Office 97
Shared code, suite-wide Visual Basic for Applications, and a new collaborative information manager keep this suite ahead of the pack. Microsoft, Redmond, WA; (206) 882-8080; http://www.microsoft.com.



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C:\My Document
C:\My Documer
C:\My Documer
C:\My Docum
C:\My Docum
C:\My Docum
Subject: Screenshots
Entry type: E-mail message
Contact: Russell Kay

Microsoft SQL Server 6.5
Faster than version 6.0 with better administration tools than its closest competitors in our last roundup. Microsoft, Redmond, WA; (206) 882-8080; http://www.microsoft.com.

NEC Versa 6030H
One fast notebook, and one of the easiest to use. NEC Technologies, Itasca, IL; (630) 775-7900.

Netscape Navigator 3.0
One browser feature short of the kitchen sink. Netscape Communications, Mountain View, CA; (415) 254-1900; http://home.netscape.com.

Next WebObjects Pro
Powerful cross-platform middleware for Web applications.Next Software, Redwood City, CA; (415) 366-0900; http://www.next.com.

Novell NetWare 4.11
The "Green River" upgrade delivers IntraNetWare. Novell, Orem, UT; (801) 222-6000; http://www.novell.com.

Power Computing PowerTower 180
When this first PowerMac clone shipped, it included a faster 604 CPU than any Macs Apple was selling at the time. We consider it a multimedia author's dream machine. Power Computing, Round Rock, TX; (512) 388-6868; http://www.powercc.com.

Powersoft Optima++
RAD for Windows 95 and NT that's a drag-and-drop dream for developers of client/server applications. Powersoft, Concord, MA; (508) 287-1500; http://www.powersoft.com.

Ross SPARCplug
Small SPARC workstation that fits in two half-height drive bays of a host PC and communicates with the host via X Window over fast Ethernet. Ross Technology, Austin, TX; (512) 349-3108; http://www.ross.com.

Toshiba Satellite Pro 410CDT
A fast, full-featured portable with a pinpoint sharp color active-matrix screen. Toshiba International, Houston, TX; (713) 466-0277; http://www.toshiba.com.

Vinca StandbyServer 32
An adapter card for inexpensively ($2599) mirroring NetWare servers. Vinca, Orem, UT; (801) 223-3100; http://www.vinca.com.

Awards of Merit

Acer AcerNote Nuevo
Notebook with innovative power-saving technology. Acer, San Jose, CA; (408) 432-6200; http://www.acer.com.

continued

when the then-standard 486 topped out at 60 MHz. The Alpha continues to reign as a CPU performance leader.

Hewlett-Packard LaserJet Si series
The speed and sharp print quality of this behemoth laser printer almost single-handedly created the market for workgroup printers.

IBM RS/6000
IBM's RISC workstation introduced many to superscalar architecture at a competitive price.

IBM ThinkPad series
With its distinctive eraserhead pointing device, this family of notebooks provides the bellwether for performance and dazzling displays in mobile devices.

Intel 486
The processor that introduced an integrated FPU, on-chip cache, and pipelining to the x86 family.

Intel Pentium
This continuation of the x86 lineage doubled the performance of its predecessor and helped Intel fight off attacks from RISC competitors.

Lotus Notes 3.0
Thanks to its unique replicated message system, Notes became the standard for blending e-mail, conferencing, and client/server database technology for groupware.

Microsoft Office
A business suite at its best with Word, Excel, Access and now tools for fast publishing of files on the Web.

Microsoft OLE Custom Controls
The Windows component model opened up componentware to a huge market of third-party developers.

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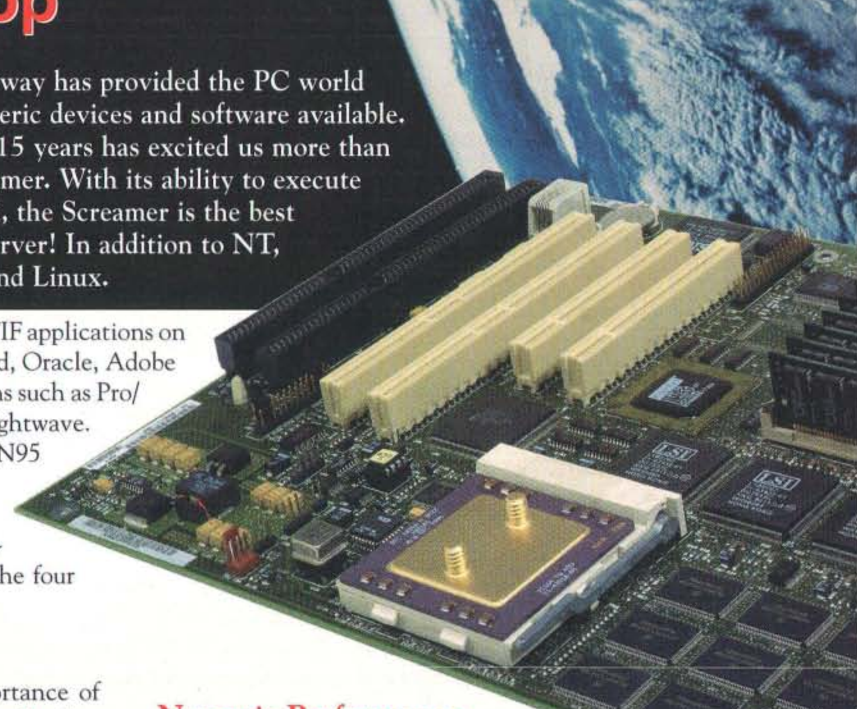

This means you can run many of your VAX and MOTIF applications on the same hardware that runs Microsoft Excel or Word, Oracle, Adobe Photoshop; plus engineering and graphics applications such as Pro/Engineer, Microstation, AutoCAD, Softimage and Lightwave. Plus, Digital's FX!32 makes it possible to run 32-bit WIN95 and NT applications on the Alpha. Over the last 15 years we have designed systems for thousands of satisfied customers including many prestigious institutions. Our technicians are expert at configuring the four Alpha operating systems we support.

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To take advantage of these resources, Microway installs the best graphics and hard disk controllers available, including controllers appropriate for 2 and 3D Graphics Workstations and RAID powered Servers.

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Microway produces one of the finest numeric optimized compilers - NDP Fortran. Since 1986, hundreds of applications have been ported to the X86 with it, including industry standards like MATLAB and ASPEN. Our latest RISC scheduler has a number of features that take advantage of the Alpha's quad-issue capability. Running on a 500 MHz 21164 that bursts at 1 gigaflop, a dot product kernel we use for compiler testing runs at a mind-boggling 940 megaflops!!!

For a complete description of the optimization facilities provided by NDP Fortran or C, our Screamer Systems and motherboard pricing call **508-746-7341** or visit our WEB Site at: **http://www.microway.com.**

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NT, Excel and Word TM Microsoft.
Screamer, NDP Fortran and Microway TM Microway.

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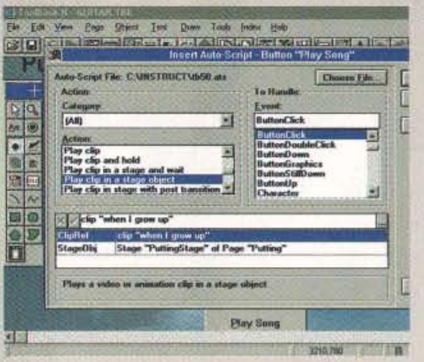
www.microway.com, info@microway.com • France 33 146229988 • Germany 49 6997650001 • India 91 806637770
Italy 39 27490749 • Japan 81 64593113 • Korea 82 25981623 • Poland 48 22487172 • United Kingdom 44 1815415466

Apple Newton OS 2.0

Existing problems have been fixed, and this PDA OS offers better connectivity compared to earlier iterations. Apple Computer, Cupertino, CA; (408) 996-1010; http://www.apple.com.

Asymetrix ToolBook II Instructor 5.0

The leader in multimedia authoring tools. Asymetrix, Bellevue, WA; (206) 462-0501; http://www.asymetrix.com.


Insert Auto-Script - Button "Play Song"
Auto-Script File: C:\INSTRUCT\tb50.ats
Category: (All)
Event: ButtonClick
Action: Play clip in a stage object
clip "when I grow up"

ClipRef	clip "when I grow up"
StageObj	Stage "PuttingStage" of Page "Putting"

Plays a video or animation clip in a stage object

Borland C++ 5.0 Suite

Major revision of a classic, with bundled products that take developers from project inception to deployment. Borland International, Scotts Valley, CA; (408) 431-1000; http://www.borland.com.

Canon inks

Photorealistic inks for ink-jet printers improves reproduction of photographs. Canon Computer Systems, Costa Mesa, CA; (714) 438-3000; http://www.ccsi.canon.com.

Cheyenne's ArcServe 6.0

Excels at file-level backup and restoration tasks. Cheyenne Software, Roslyn Heights, NY; (516) 484-5110; http://www.cheyenne.com.

Connectix VideoPhone 1.1

An easy-to-use and inexpensive package for basic videoconferencing. Connectix, San Mateo, CA; (415) 571-5100; http://www.connectix.com.

Emultec Simulator

Without programming, this innovative product lets you create sophisticated simulations for computer-based training or product demonstrations. Emulex, Costa Mesa, CA; (714) 662-5600; http://www.emulex.com.

Hewlett-Packard Vectra XU 6/150

Best of the first dual-CPU 150-MHz Pentium Pro PCs we tested. Hewlett-Packard, Palo Alto, CA; (415) 857-1501; http://www.hp.com.

Hewlett-Packard Deskjet 1600CM

Network-ready color ink-jet printer with stunning output. Hewlett-Packard, Palo Alto, CA; (415) 857-1501; http://www.hp.com.

Innovative Software's OEW for Java

Object Engineering Workbench provides a visual programming environment for Java. Innovative Software Development, Englewood, CO; (303) 220-1500.

Macromedia FreeHand Graphics Studio 7

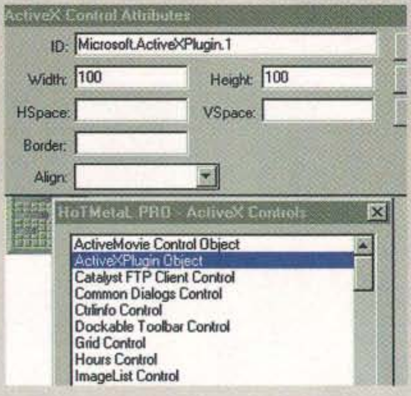
Four cross-platform graphics programs that provide everything from illustration and page design to 3-D modeling. Macromedia, San Francisco, CA; (415) 252-2000; http://www.macromedia.com.

Microsoft Exchange Server

E-mail on steroids. Microsoft, Redmond, WA; (206) 882-8080; http://www.microsoft.com.

Microsoft FrontPage

Easy-to-use development tool for less-complex Web sites. Microsoft, Redmond, WA; (206) 882-8080; http://www.microsoft.com.


ID: Microsoft.ActiveXPlugin.1
Width: 100
Height: 100
HSpace:
VSpace:
Border:
Align:

HoTMetaL PRO - ActiveX Controls: ActiveXPlugin Object

Netscape LiveWire

For content-rich development of complex Web-sites, LiveWire is especially effective when you team it with server-side JavaScript. Netscape Communications, Mountain View, CA; (415) 254-1900; http://home.netscape.com.

Novell GroupWise 5

Significantly improved document management capabilities added to messaging, calendaring, and scheduling tools. Novell, Orem, UT; (801) 222-6000; http://www.novell.com.

Star Division's StarOffice 3.1

An office suite that is one of the first to integrate Web features. Star Division, Edina, MN; (612) 943-1565; http://www.stardiv.de.

Verilog's ObjectGeode

Object-oriented CASE for the real world. Verilog, Bagnuex, France; +33 1 665 7070.

Microsoft Visual Basic

Visual programming for GUI and Windows development reached a broad audience when VB arrived.

Microsoft Windows 3.x

Overcoming earlier missteps, Windows 3.0 started a flood of applications and the desktop environment most users live in today.

Microsoft Windows NT

Windows with preemptive multitasking, multiprocessing, and reliability for servers and power-hungry workstations.

Netscape Navigator

Navigator has defined sophisticated Internet browsers with multithreading capabilities and multiple active panes that enable efficient display of complex information.

PCI Special Interest Group PCI 2.0

PCI fulfills the local-bus design needs of Pentium- and RISC-based systems.

PCMCIA (PC Card) 2.0

This specification first defined how pocket-size cards would support modems, printers, and other general I/O devices.

Sun Microsystems Java

An interpreted programming language that is the newest best hope to fulfill the promise of delivered-on-demand software that runs on streamlined, distributed systems.

Sun SparcStation 1

SparcStation and workstation became synonymous for many people when Sun introduced this new standard for price and performance.

Unix System V

There's still no single standard for Unix, but System V version 4 came close by unifying Xenix, SunOS, 4.3 BSD, and System V.

New hand-held Windows PCs truly synchronize with desktop systems. ***By Peter Wayner***

At Last: Pocket PCs That Run Windows

For years, pocket organizers have lurked in a shadow world between mainstream PCs and stereo equipment, selling through gadget stores like Sharper Image instead of CompUSA. Windows CE may change all that. Microsoft has stripped down 32-bit Windows to its bare essentials—creating an operating system small enough to run on a hand-held computer. CE (once known as "Pegasus") may eventually run on many different small or embedded computers, but it is first being introduced to the world as the OS for palmtop computers.

I tested three of the first CE units, from Compaq, NEC, and LG Electronics (familiar for its Goldstar monitors). Of similar size and weight, all three have a simple clamshell design with a 480- by 240-pixel touch-sensitive black-and-white LCD screen, a miniature QWERTY keyboard, one Type 2 PC Card slot, speakers, and ROM-based Windows CE. All sell for around $500 with 2 MB of RAM (and 4 or 8 MB of ROM). I tested 4-MB models that go for around $650.

Casio manufactures the Compaq unit and sells identical hardware, as the Cassiopeia, with a different software bundle. Hitachi will sell a version of the LG Electronics hand-held, which is powered by Hitachi's SH3 RISC CPU. Hewlett-Packard and Philips are bringing out CE hand-helds, too (see "More Better HPCs" on page 134).

LG HPC

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★

NEC MOBILEPRO

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★

PHOTOGRAPHS: BRIAN WILDER © 1997

To distinguish CE computers from palmtops, organizers, and personal digital assistants, Microsoft is pushing the designation HPC (for "hand-held PC"), an acronym I will observe for brevity. This distinction might prove important, but the current crop of HPCs offer many of the same features as regular PDAs and palmtop organizers. They keep track of your appointments, phone numbers, and notes. Like some recent PDAs, HPCs can automatically synchronize this data via serial port with software on your desktop system.

The big HPC advantage is Windows CE, stored in ROM. If you use Win 95, you'll feel right at home, from the bottom-left Start button that grows into a menu tree to each application's close button in the upper-right corner. CE comes with downsized versions of Windows applications that synchronize with their desktop equivalents.

The applications include the most sophisticated word processor and spreadsheet I've seen on a pocket machine. The HPCs' tiny keyboards will be a hindrance, but you can browse and edit documents created by the desktop versions of the applications. (I quickly abandoned my effort to write this article on one of the review units.) People are likely to buy HPCs for organizing their lives, not for word processing.

But there are also interface differences appropriate to the small screen of a hand-held device. The Start menu doesn't build into a multilevel tree, for example, and there is no right mouse button to pop up context menus because you use a stylus (or a finger) and select by tapping. Unlike a desktop application, a good CE program is either minimized to the task bar or maximized to fill the screen.

COMPAQ PC COMPANION

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★

Memory also constrains the applications shipped with CE. Although they are called Pocket Word, Pocket Excel, and Pocket Internet Explorer, the pocket versions have considerably fewer features than their full-grown siblings. For instance, Pocket Word will allow you to change the font or use the outliner, but it won't let you set the margins. The three small menus bear only a distant relationship to standard Microsoft Word. Pocket Word is a fine application for an HPC,

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

but the note processor on the Apple Newton, for example, has almost as much in common with Microsoft Word as does Pocket Word.

The Web browser is surprisingly useful, although it has few buttons and has to run on such a small screen. Its usefulness is a testament to the brilliance behind Hypertext Markup Language (HTML) and its all-encompassing approach to fitting any local screen. Of course, you can tune your pages to the small display by minimizing the graphics and avoiding any shades or colors that will be lost as they're converted to four levels of gray.

The HPC design sets a new display standard for palmtops. The 480- by 240-pixel screens are larger than most pocket organizers and look significantly better than most, though with four gray levels and little or no backlighting, they don't compare to the bright color displays of notebook computers. But then, an HPC must be able to run for several days on two AA batteries. The CE specification mandates some means of adjusting screen contrast, either with the keyboard or with a wheel, which is preferable.

More Better HPCs

If you don't like the three HPCs we review here, you can soon go to Philips or Hewlett-Packard. Both companies promise units with more functionality in critical areas than current HPCs.

HP's unit will offer a 640- by 240-pixel display. The wider screen will be particularly welcome for reading e-mail without horizontal scrolling. Whether or not there are size and power trade-offs remains to be seen. HP also promises more bundled software than current hand-helds provide.

Philips' Velo machine will have a "standard" 480 by 240 screen, though with backlighting. The neat part about Velo is the two-chip RISC CPU, developed by Philips, that offers all the hardware functions required by an HPC, including a multiply/accumulate unit to assist the MIPS R3900 core in providing a very power-efficient 19.2-Kbps fax modem, which is built into the little machine.

The Velo supports two Intel Miniature Card modules that can be used to add either RAM or Flash RAM. Unlike PC Card memory, this RAM acts as system memory, so you can upgrade to as much as 36 MB. If you want to use PC Cards, a slap-on base provides a single slot. The Velo docking module will provide one-step battery recharging and data synching. Like HP, Philips will offer more software than currently comes with other HPCs, including Pocket Quicken, a database application, and extensions to the Windows CE e-mail functionality. The Velo with 2 MB of RAM is $599; the 4-MB model is $699, higher than other HPCs now on the market.

Typing on tiny keys with two fingers is tough, but I also found that the typical HPC clamshell case just isn't as comfortable to use as either Apple's Newton or US Robotics' Palm Pilot. My left thumb often grew tired from holding the HPC after only a few minutes of my right-finger typing. As ridiculed as the Newton was, I found myself wishing for its handwriting-recognition abilities.

I also found it awkward to switch back and forth between the keyboard and the stylus. My best solution was to hold the clamshell in my left hand and the stylus between my right index finger and thumb while typing with my right middle finger. I would welcome something like the new Graffiti software distributed with the Newton and the Palm Pilot.

Size might also be a concern. Although they fit snugly in a suit jacket pocket, HPCs are large and heavy enough to create a significant bulge. It's not like carrying around a sleek cell phone.

With plenty of pocket organizers priced between $100 and $250, you might think twice about the cost of HPCs. The screens of pocket machines are significantly smaller, and these devices don't pretend to run Windows 95, but they take names, numbers, and notes and also synchronize data with a PC.

Compaq's PC Companion

ADVANTAGES:

+ Backlit screen
+ Screen-contrast adjustment wheel
+ Hidden power switch

DISADVANTAGES:

– Stylus easily lost

Though the three reviewed HPCs are nearly interchangeable, Compaq's PC Companion comes out on top in aesthetics. The PC Companion's best feature is its backlit screen, which extends the range of conditions under which the display remains usable. The PC Companion's contrast-adjustment wheel also helps you get the most out of four dim shades of gray. The price for backlighting is increased power consumption, so use it only when you have to.

The PC Companion is Compaq's version of Casio's HPC. It's based on Hitachi's SH3 processor. The PC Companion takes one PC Card device. The cradle provides power charging, but you need to hook up the separate serial cable for data synching. Unfortunately, the unit's external stylus holster leaves the stylus partially exposed. If you lose it, your $500-plus HPC becomes significantly less useful.

continued

TECH FOCUS | PROGRAMMING

Developing for Windows CE

Microsoft has designed the Windows CE API as a subset of the Windows 32-bit API (approximately 25 percent of it). All the basic calls are familiar. If a programmer wants to put up a window or manipulate the screen, then the data structures and procedure calls will be exactly the same. Of course there are challenges. The screen of the target device is much smaller, and the behavior of the windows is somewhat limited. Developers must pay attention to the little amount of available RAM and current lack of color displays.

Windows CE is currently on several hardware platforms, including Mips (NEC's VR 4101 and the R3900 core in Philips' chip set) and Hitachi's SH3. Like NT, Windows CE is isolated by a hardware abstraction layer (HAL), which keeps low-level programming to a minimum. Manufacturers don't have to spend time writing device drivers and glue code. Programmers are writing CE code on NT desktop systems using simulation of the CE environment.

At this time, however, developing for CE is an option available only to a select group. You can't yet simply purchase a compiler and an SDK and write your own applications. Contrast this with the US Robotics Palm Pilot. You can build programs for that hand-held machine using Metrowerks' CodeWarrior 10, which comes with development tools for the Pilot and for devices based on General Magic's Magic Cap (see our CodeWarrior review on page 47).

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Circle 229 on Inquiry Card.

Windows CE HPC Features

	Compaq PC Companion C140	**LG Electronics LG HPC GP40M**	**NEC MobilePro 400**
Processor	Hitachi SH3	Hitachi SH3	NEC VR 4101
Screen resolution (pixels)	480x240	480x240	480x240
Backlit screen	✓		
Display gray levels	4	4	4
Dimensions (inches)	6.8x3.6x1	6.5x3.8x1.1	6.9x3.7x1
Weight (pounds)	0.89	0.77	0.85
Typical battery life (AA) (manufacturer's estimate)	up to 20 hours	15 hours	30 hours
Batteries	two disposable AA (rechargeable optional)	two disposable AA (rechargeable optional)	two disposable AA (rechargeable NiMH optional)
PC Card slots	one Type 2	one Type 2	one Type 2
RAM	4 MB	4 MB	4 MB
ROM	4 MB	4 MB	8 MB
Fax modem built in		✓	
IrDA port (115 Kbps)	✓	✓	✓
Serial port for synchronization	✓	✓	✓
Cradle for recharging	✓	cable only	✓
Estimated street price (as tested)	$600	$650	$650

✓=yes

The LG HPC

ADVANTAGES:

- + Built-in modem option
- + Secure slot for stylus
- + Built-in charger

DISADVANTAGES:

- – Lacks convenience of docking module

The best part about the LG unit is its optional built-in modem. Somehow, the folks at LG Electronics found just enough room to add a modem with a standard jack on the side of the machine. This frees up the PC Card slot for other things. Of course, running a modem uses lots of power and should be done with care and a rechargeable battery pack, although the built-in device should be more power-conserving than a PC Card modem.

The LG is also alone in storing its stylus securely inside the clamshell. You can activate the touchscreen with your fingertip, but you have to do so very precisely . Windows CE does have many keyboard shortcuts, but you don't want to try to edit text without a stylus.

I found the LG HPC's screen comparable to the NEC MobilePro's but of course not as readable as the backlit Compaq PC Companion's. Though the LG HPC has no docking module option, it does have a built-in charger. You plug in the AC adapter if you're using rechargeable batteries and attach the serial cable for synching with your desktop PC.

Hitachi has an HPC based on the LG model. It's comparable to the products we reviewed. Prices start at $499 for a unit with 2 MB of RAM.

The NEC MobilePro

ADVANTAGES:

- + Semi-protected stylus
- + One-step docking cradle
- + Nice alarm light

DISADVANTAGES:

- – Exterior power switch

The most visible difference between NEC's MobilePro and the other two HPCs is its external power switch; it's outside the clamshell. The switch is lighted so it can also act as a visual alarm. While there may be something stylish about merging these two features, it creates a potential problem in that you can turn on the unit accidentally. This risk is minimized by the fact that Windows CE is smart enough to turn off during periods of idleness.

The MobilePro has twice as much ROM as the other two units, though the benefit isn't yet apparent. Providing neither modem nor backlighting, NEC also has the most optimistic claims about battery life.

The stylus to the NEC is easy to get to and somewhat protected when the lid is closed. The lip partially covers the stylus and keeps it from sliding out. If this design were a bit more protective, it would be the best compromise between security and accessibility.

The MobilePro comes with a cradle. Unlike the Compaq or Casio docking cradles, the NEC cradle allows one-step docking. Plugging the MobilePro into its cradle connects both the AC adapter and the serial connection.

Noted with Pleasure

The HPC moniker is more appropriate than most in the world of computer hype. With Windows CE, these machines are just like PCs that you can hold in your hand. The Apple Newton, the Sony MagicLink, and the US Robotics Palm Pilot still come bundled with the attitude that they've been beamed in from *Star Trek* land. HPCs are more humble. They have a screen, a keyboard, and a stylus that acts like a mouse, and their sole job is to act like Windows 95. The screens may be small and gray, the keyboard tiny, and the stylus a pain to juggle, but the package is worth considering if you have to take your computer on the road. Even 7-pound notebooks can feel heavy when you walk through an airport with other luggage. ■

PRODUCT INFORMATION

Compaq PC Companion
$600
(2 MB of RAM)
Compaq Computer
Houston, TX
(800) 345-1518
http://www.compaq.com/
Circle 1109
on Inquiry Card.

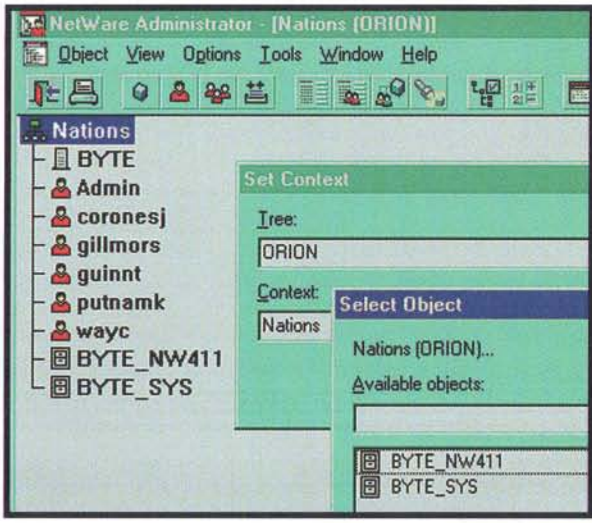
LG HPC
$650
(4 MB of RAM, fax modem)
LG Electronics
Englewood Cliffs, NJ
(201) 816-2000
http://www.lge.co.kr/
Circle 1110
on Inquiry Card.

NEC MobilePro
$649 (estimated street price)
(4 MB of RAM, cradle)
NEC Computer Systems
Mountain View, CA
(800) 632-4636
(508) 264-8000
http://www.nec.com/
Circle 1111
on Inquiry Card.

Peter Wayner is a BYTE consulting editor. You can reach him at **pcw@access.digex.net** *or view his home page at* **http://www.access.digex.net/~pcw/pcwpage.html.**

With its newest NetWare upgrade, Novell confronts the intranet and the reality of TCP/IP. ***By Steve Gillmor***

Dial 411 for Directory Assistance



Tree: ORION

Context: Nations

Nations (ORION)...

NetWare 4.11, IntranetWare
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Orem, UT

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fax: (800) 453-1267

http://www.novell.com/

Circle 1063
on Inquiry Card.

With the new NetWare Administrator, you can drag and drop between multiple directories.

The release of NetWare 4.11 and its companion product, IntranetWare (see the Tech Focus on page 138), marks an important moment in Novell's transition to Web-based technologies. This evolutionary (.01) update, formerly codenamed Green River, integrates key third-party utilities, strengthens NetWare's lead in directory services, and begins the perhaps-inevitable migration from Novell's proprietary IPX protocol to the Internet's TCP/IP.

Novell has emulated elements of Microsoft's Windows NT Server strategy in bundling a number of previously separate utilities with the core 4.11 server. For example, symmetric multiprocessing (SMP) for as many as four processors, once available only from supporting hardware vendors, comes ready to go; the improved installation program automatically detects additional processors, and you can purchase add-on SMP support for as many as 32 CPUs in one server.

I found 4.11's hardware detection to be vastly enhanced; it seamlessly detected a wide range of hard disks, CD-ROM drives, and LAN cards—even IDE devices. Although I wasn't using an EISA-bus server, the C-Worthy installation program asked for slot numbers for the EISA bus; however, it seemed happy with a random response.

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★

Novell has incorporated a subset of Preferred Systems' popular DS Standard tools, renamed DS Migrate, into NetWare 4.11. This aids modeling and printing and simplifies the migration of more complete NetWare 2.1x, 2.2, or 3.1x bindery information to NetWare Directory Service (NDS). Server files are then migrated with the new File Migration utility, which can run from a Windows 3.1x or Windows 95 NetWare client. You can still use the DOS-based MIGRATE.EXE, but that legacy tool doesn't include modeling functionality.

NetWare Administrator (NWAdmin) comes in both Windows 3.1x and Win 95 flavors and takes NDS to the next generation, for the first time allowing administrators to navigate among multiple trees and contexts using graphical drag-and-drop editing. Now you can select any of the trees you're logged in to from the Set Context option in the View menu. Click the Tree icon, and you can view all the trees on the network; you can then graphically select the context rather than having to type it in.

User Templates allow you to specify default values for new users. The Details On Multiple Users option enables you to modify existing property values for multiple objects in one step, and you can configure NWAdmin's toolbar to give you instant access to your favorite tools. NDS Manager (which is an enhanced GUI version of Partition Manager) allows you to create and manage NDS replicas across the tree; you can also update any or all servers to the latest NDS version across the network.

The improved NetWare Application Launcher (NAL) utility exploits NDS's object technology to streamline application services. You can control access; define directory, icon, and command-line parameters; and define start-up scripts to house drive mappings, print captures, and other settings. Users simply click on the provided icon, and NAL sets up the workstation and launches the application according to the object's properties.

In terms of applications, NetWare 4.11 is much more robust in handling an abnormal end (`abend`) to a NetWare loadable module (NLM) process. The server console now identifies the errant code or hardware problem; you can configure the

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

TECH FOCUS INTRANET

What's an Intranet OS?

What's the difference between a network OS (NOS) and an intranet OS? Novell clearly raises that question by selling two products: Its traditional NetWare and the new IntranetWare, a superset of NetWare.

Novell's answer is that NetWare incorporates five key services (file, print, directory, security, and management), to which IntranetWare adds three more (messaging, Web publishing, and wide-area connectivity) that give a network access to the Internet, the Web, and local Hypertext Markup Language (HTML) pages. That defines the difference.

Thus, the IntranetWare package includes NetWare 4.11 but moves beyond it with Internet Access Server—which is a bundling of Novell's IPX/SPX-to-IP gateway, the Multiprotocol Router (MPR), an ftp server, and Netscape's Navigator 2.01 browser. The IPX/IP gateway server allows IPX clients to access the Web without loading a TCP/IP stack on each workstation. Administrators can use NetWare Administrator to configure Internet access on both a port (Web, ftp, or telnet) and IP-address basis.

MPR addresses the emerging need for increased bandwidth, providing software-based wide-area routing with WAN extensions, including ISDN, leased lines, frame relay, and ATM links. All ftp services can be configured for anonymous access, and the Netscape Navigator license can be applied to a more up-to-date version of the browser.

Both packages contain NetWare/IP 2.2 (with DHCP support), NetWare Web Server 2.51, and NetBasic for the Internet. Configuring NetWare/IP requires some knowledge of the Domain Naming System (DNS) and the Domain SAP/RIP Service (DSS), but NetWare automatically migrates the settings on subsequent installations.

NetWare Web Server leverages NetWare Directory Service (NDS), giving administrators control over Web-browser access to documents based on IP address, NDS authentication, or file-based directory-access rights. You can publish static documents for intranet or Internet access or write BASIC or Perl scripts to dynamically serve HTML pages in response to browser requests. Two forms of Common Gateway Interface (CGI) are supported—a remote version (called RCGI), which can run on multiple platforms, and a local version (called LCGI), which must be coded as a NetWare loadable module (NLM) for faster execution. Java applets and JavaScript round out the programming toolkit.

Standardizing on the Visual Basic-like NetBasic scripting tool makes it easier for developers to use NetWare; Novell's Net2000 APIs expose NDS to access by ActiveX controls, PowerBuilder, Delphi, and other popular tools. The included NetBasic scripting interpreter can extend Web-browser access from read-only to allowing more robust interactive capabilities.

NetWare 4.11 and IntranetWare are available for the same price, so it makes little sense to buy the lesser product. Once you've installed IP services in whatever combination best serves your enterprise, you can make on-line documentation available on the intranet via Novell's proprietary DynaText hypertext reader. The Internet Access Server software documentation is provided in HTML format, while the MPR and NetWare 4.11 text exists only in DynaText format.

Whichever product you choose, Novell has come a great distance in adopting the requirements of both the Web and 32-bit Windows. NetWare/IP and the IPX/IP gateway ease the transition to TCP/IP, while the enhanced Client32 tools seamlessly integrate NetWare services into Windows 95's Network Neighborhood and other system utilities.

server to automatically shut down and restart, or you can manually halt the corrupted process and allow more time for cleaning up other tasks. NetWare is still vulnerable to poorly written NLMs, but abend auto-recovery preserves more clues for isolating the problem.

File and print services are improved in the new release. You can direct NetWare's file services to automatically compress files (selecting by file, directory, or volume), which can cut your disk requirements in half. You can also direct NetWare to automatically move certain data to less expensive storage devices (which is known as built-in hierarchical storage management). The new NPRINTER Manager allows the sharing of printers attached to Win 95 workstations.

To Upgrade or Not?

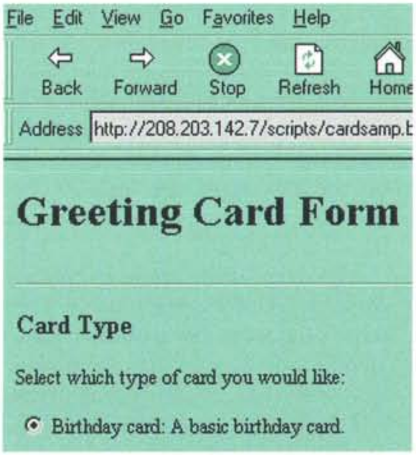
NetWare is still a high-performance vehicle that requires an on-staff mechanic. Even with improved auto-detection and configuration, this suite of tools does not match Windows NT's user-friendly look and feel. NetWare veterans will appreciate the many administrative enhancements, but more work needs to be done to make the intranet/Internet tools an integral part of the environment.

Novell is positioning NetWare 4.11 as the solution for the significant percentage of its installed base that has no interest in Internet connectivity. Web Server is included, however, to whet the appetite of those who recognize the need to wed an intranet with the Internet. With IntranetWare, Novell remains a major player in the network game.

NetWare shops will have no trouble with either version. The bundled applications alone represent a value of thousands of dollars; Web Server, for example, was previously priced at $1595.

But Microsoft, fresh from opening up Netscape's lock on the browser market, can be expected to continue adding value to NT Server. NetWare's Achilles' heel remains its lack of off-the-shelf application support, and Novell seems to be betting the farm that future Java applications will overtake Windows. However, Microsoft's ability to blend its dominant desktop product line with its server tools creates a momentum that may prove to be impossible to blunt. **B**

Steve Gillmor, who works at Southern Digital, Inc. (Charleston, SC), has extensive experience with networks and groupware. You can reach him at **sgillmor@aol.com**.



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NetWare 4.11 includes the NetWare Web Server and support for NetBasic.

Review

Database-Development Tool

Wall Data's Salsa lets nonexperts create database applications simply and quickly, and with minimal coding. By Russell Kay

Hot Sauce for Cooking Up Databases

Salsa for the Desktop 2.2 is one hot package for creating Windows database applications with a minimum of programming, using a visual, object-oriented environment. Wall Data built Salsa around an appealing notion: You do the things that people do well (describe your data and business objects) and let the computer handle all the down-and-dirty details of implementation.

I used Salsa to create a database application to catalog and cross-index an extensive record collection, down to the level of individual album tracks and songs, composers, and performers. I'd tried to create such a database four times before. However, I had given up because establishing and maintaining the complex many-to-many links was too hard to do with other tools. Salsa seemed like the first product that would let me do it without going back to graduate school.

You start by creating an object by drawing a box in the workspace, naming it, and dragging other objects, data elements, items, or groups into it. Salsa comes with a large number of common, predefined objects; many more are available in a series of specialized starter kits ($49 each, $149 for all 10). You can also roll your own. If you right-click on an object or data item, an extensive property sheet comes up for you to edit. For example, one pair of properties—so useful that they're always visible as subscripts to the item name in the object box—is the minimum required (usually 0 or 1) and maximum permitted number of instances (usually 1 or *n*).

You link one object to another simply by dragging the header of the first into the body of the second. Salsa simplifies building complicated databases by assuming that all relationships are bidirectional and many-to-many.

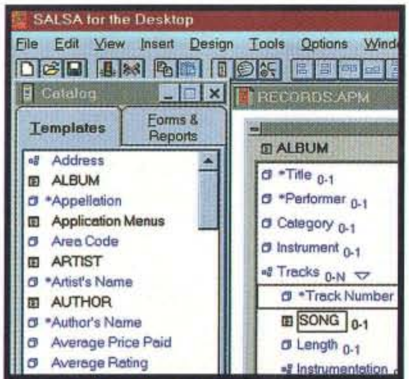
I created the data model, established the links, and clicked on TestDrive to create the databases, forms, queries, and reports. While refining the data-input form to add a drop-down pick list for one particular field, I was startled to find that I'd reached and exceeded the limits of Salsa's visual-programming capabilities and had entered a decidedly different world. System help messages directed me to create an unbound control combo box, reset certain of its properties, and write some lines of code for the change event to link it to a bound control.

Bound and unbound controls? Change event? Code? Where and what were these things? By systematically trying all the menu options, I found the mysterious change event by clicking on Scripting under the Tools menu. After conquering that obstacle, I soon discovered, among other things, that Salsa is fussily case-sensitive, differentiating between Stylebox .AddItem and Stylebox.additem (wrong). And I learned that there are easier ways to add pick lists than that which the help system suggests.

Previous versions of Salsa relied on a proprietary database engine. Now, Salsa can create Microsoft Access database files via Open Database Connectivity (ODBC), and other standard DBMS formats are in the works. In this version, you can use either the Access or proprietary formats as your default storage model.

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★

Complementing the $350 Salsa is a new $49 run-time version that lets you run and distribute a Salsa application, create new data, build queries and reports—indeed, you can change just about anything but the underlying data model.



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$350

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fax: (415) 856-9265
http://www.walldata.com/

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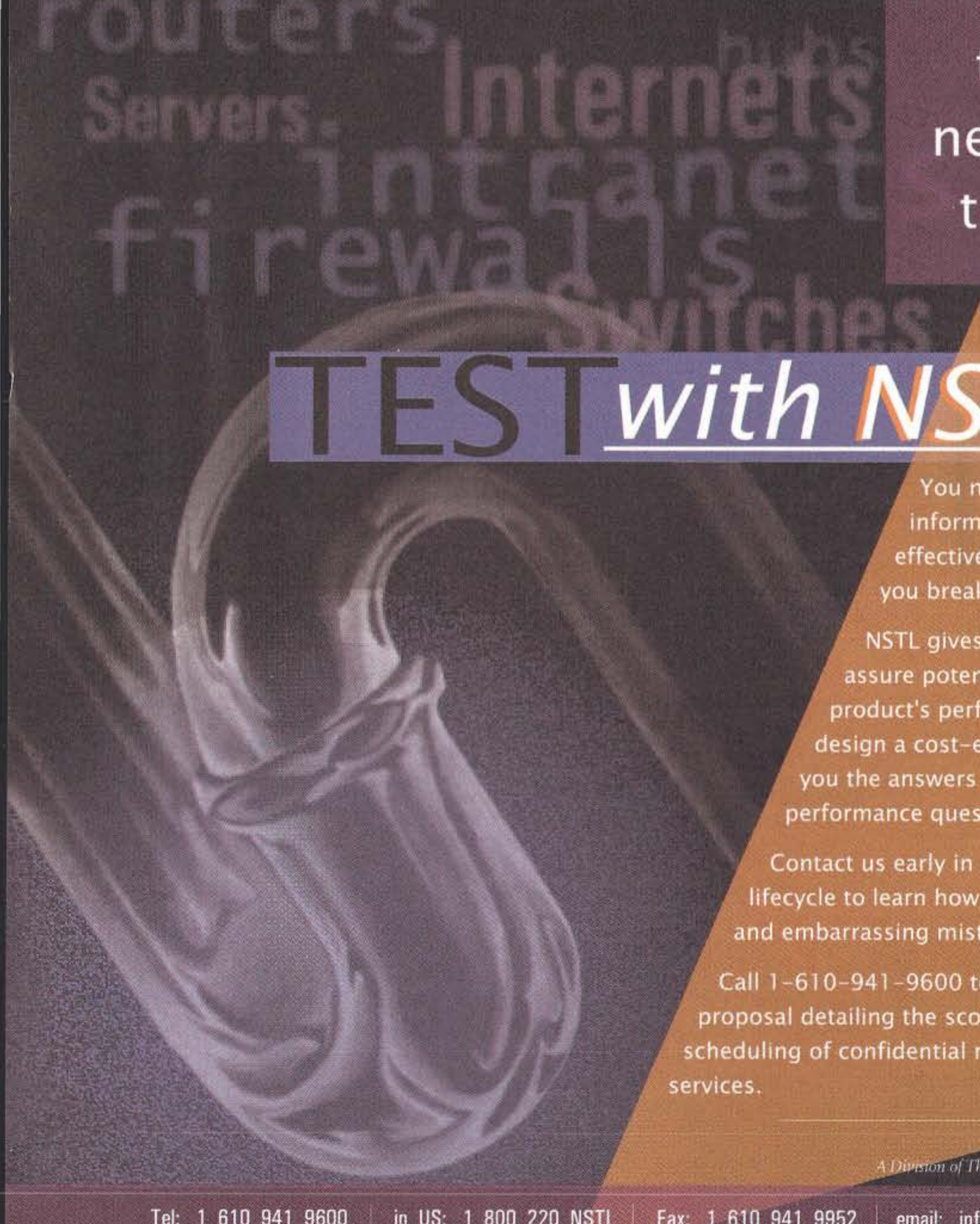
A few weeks after you buy Salsa, a technical-support person will call to arrange a 1-hour phone-support session to help you build an application and talk you through any rough spots.

On reflection, Salsa is both less and more than I'd hoped for. Less, because it doesn't perform magic and do what I was thinking—talk about unrealistic expectations! More, because it helped me create a complex application on which I'd previously given up.

When I approached Salsa with the perspective of an unsophisticated user, to get a simple version of the application working well before adding the bells-and-whistles refinements, my applications came together smoothly and swiftly. This powerful and capable program let me do things I couldn't figure out with other database packages. **B**

Russell Kay, a BYTE technical editor, spent years as a dBase II programmer on CP/M systems. You can reach him at **russellk@bix.com.**



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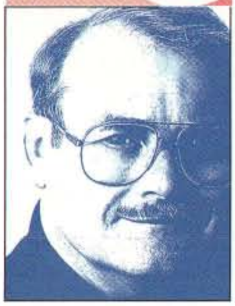
Jerry Pournelle

Chaos Manor



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A Hard Drive and a Hot Santa Ana

Another heat wave brings near disaster to Chaos Manor—and Jerry finds a novel use for a CPU fan.

My novel *Starswarm* is done, and my agent and my editor at Tor Books think it's the best thing I've ever done. I'll stop crowing any day now. Larry Niven and I expect to finish *The Burning City* about the first of the year. Clearly, my new work regime is working.

All this activity has stalled some computer projects. I had hoped, with the help of Larry Aldridge of PC Power & Cooling, to build a really fast twin-Pentium system from a Micronics motherboard and install the new OS/2 Warp that supports symmetric multiprocessing (SMP), but it hasn't happened yet.

Even so, as a result of our experience with the Diamond Flower dual-Pentium Doubleshot 133 running Windows NT 4.0, I currently recommend a dual-processor system as the upgrade of choice for everyone not running Windows 95 (Win 95) games. Don't try to speed up your old machine; get a new one and network your old one to it.

Dual-processor systems change the way artists think about graphics. David Em, one of the first fine artists to use computer graphics, had some problems with his machine, so we lent him the Doubleshot 133. He's been experimenting, watching the CPU usage meters while he manipulates large graphics images.

David finds that as soon as you have Adobe Photoshop render a large image, both processors are used 100 percent. This isn't so surprising; the astonishing thing is that you can do that kind of graphics on a desktop machine. Not long ago, you either used a Silicon Graphics workstation or learned to have lots of patience. David says that he experiments more: he's no longer intimidated by the long delays between concept and picture.

Even if games are a primary interest, you may be better off getting a good medium-speed dual-Pentium system rather than a very fast single-processor system. While NT 4.0 doesn't support Win 95 games, it does run a surprisingly large number of DOS and Windows 3.1 games. Moreover, monster hard drives are cheap, and with the aid of System Commander and Partition Magic, you can set up a dual-processor system to boot in Win 95 or DOS for games such as Crusader: No Regret, which just can't stand any kind of Windows. Any Pentium system you're likely to get will be fast enough for most of those games; and if you can get modem games running under NT (some do, some don't), the dual processors can give you a decided speed edge.

A good dual-processor system can change the way you think about graphics.

While I recommend upgrading by getting a dual-Pentium system and networking it to your old system, there is another possibility: abandoning Intel for Digital Equipment RISC-chip systems. These systems run NT just fine, and you can add as many processors as you need. I recently was the keynote speaker at a computer fair in Albuquerque, where I spent some time with Fred Feagin of Thor Computers. I remember Fred as a spacecraft designer at the Jet Propulsion Laboratory (JPL). He's now doing computer systems design.

Thor takes Digital RISC machines and adds some engineering improvements. The result is reliable and incredibly fast. I don't yet know enough about these marvels, but I will soon. The cost is now down in the high-end desktop class, meaning that systems based on Digital rather than Intel architecture are an option worth considering.

Back in 1976, I paid $12,000 for Ezekial, a 2-MHz Z80 with 64 KB of RAM, a 16-row by 64-column video board, a monochrome monitor, two 8-inch floppy drives, and a 30-cps Diablo daisy-wheel printer. That machine's on display in the Smithsonian's History of Communications and Computing exhibit. It's astonishing what that much money will buy today.

The *Los Angeles Times* bemoans the lack of trained graphic artists in the U.S. The entertainment industry is forced to import talent from overseas. What with the Internet, theme parks, TV commercials, as well as films and TV shows, there's a big demand for digital artists—and the schools aren't producing them.

The problem isn't computer literacy; it's artistic training. Apparently, we no longer teach any kind of artistic creativity in the schools.

The *Times* wants school reform. Perhaps that's needed, although I wonder what artistic training kids will get from a system that fails to teach a quarter of them to read; but however effective school reform can be, it's going to take a while. I asked David what someone interested in a position in graphic arts might do in the meantime.

"Learn to draw," David said. "Don't worry about technique; pay attention to what you see. Once you learn to see things properly, the drawing will take care of itself." We then went on a hike up my favorite hill, where I realized I wasn't seeing 10 percent of what he saw even though we were looking at the same scene.

As for tools, anyone with a Pentium system and a reasonable graphics board has most of what's required. You should learn to use a drawing pad; Wacom makes a good one for a reasonable price. For software, Caligari's trueSpace is a good beginner's program. By the time you run up against its limits, you'll know whether this is something you really want to do. For that matter, everyone has a pencil and some paper, which is not only a good way to start, but a medium you'll have to learn to work with.

The computer graphics field changes like dreams; you can now do things with desktop systems that two years ago you couldn't do with any equipment in the world. That's going to continue; and as David is fond of pointing out, it's all new. There's no 2000 years of traditional ways of doing things to weigh you down.

I've often said you don't need formal instruction to become a writer: you need to write a lot and finish what you write. Apparently, it's also that way with art. Sure, training helps, but mostly you just need to do a lot of it. I'm sure the schools need reforming, but meanwhile, there are a lot of wonderful programs out there, like Broderbund's Kid Pix Studio, to give young people an early start.

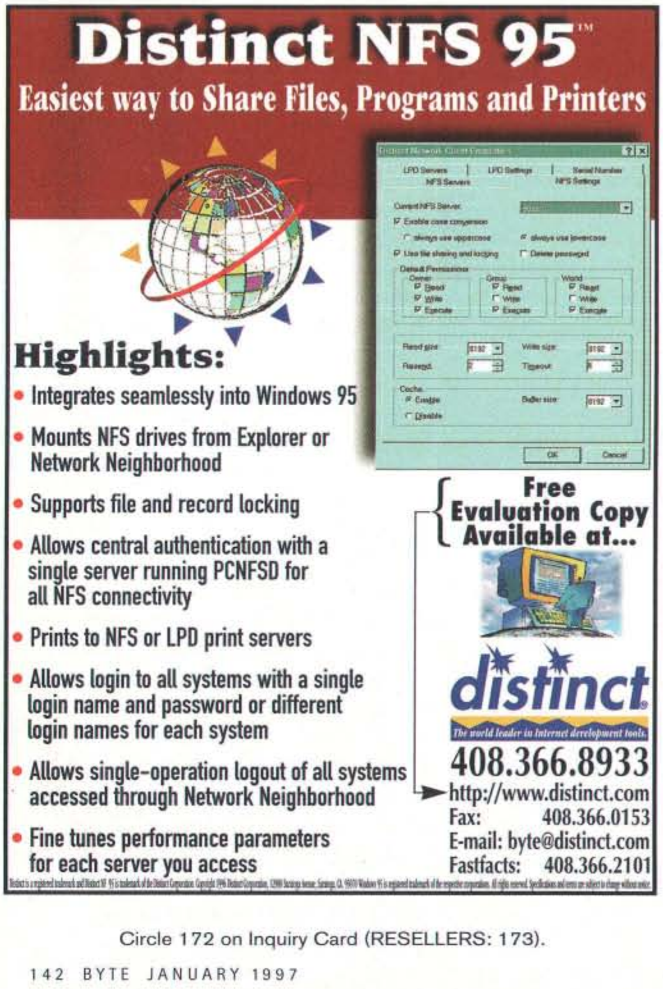
If I boot up with a cartridge in the system, it's a horrible mess.

I recently said rather flippantly that "SCSI has a mind of its own." Several readers have taken me to task for that. Perhaps they're right. What I should have said is there are a number of SCSI BIOSes out there, and they can behave rather differently, so one person's experience may not apply to another's problems.

Case in point: my trials with installing Syquest EZ135 and Iomega SCSI Zip cartridge drives and the consequent shifting of drive-letter assignments. On Cyrus, the Cyrix 6x86-P166 system, once you install the drive, you can go into Win 95's Device Manager and assign that drive a letter. My Zip drive wanted to be drive E, displacing the CD-ROM drive that resided there. Using Device Manager to assign E to the CD-ROM drive does no good whatever.

However, once you install the Zip drive, you can go into Device Manager and reserve F for the Zip drive (even though the CD-ROM drive has that letter); reboot the system; and Bob's your uncle. The Zip drive will be F whether there's a cartridge in the drive on boot-up or not.

Alas, it doesn't work that way with Pentafluge, which is my older Pentium P-60 system. I can assign the Zip drive to be G (there's a Maxoptix T3-1300 optical drive at E, and the CD-ROM drive is F), and if I boot up with no cartridge in the Zip drive, all's well; but if I boot up with a cartridge in the system, it's a horrible mess. Drives are displaced, and the Device Manager becomes very confused. I am definitely better off not assigning the drive let-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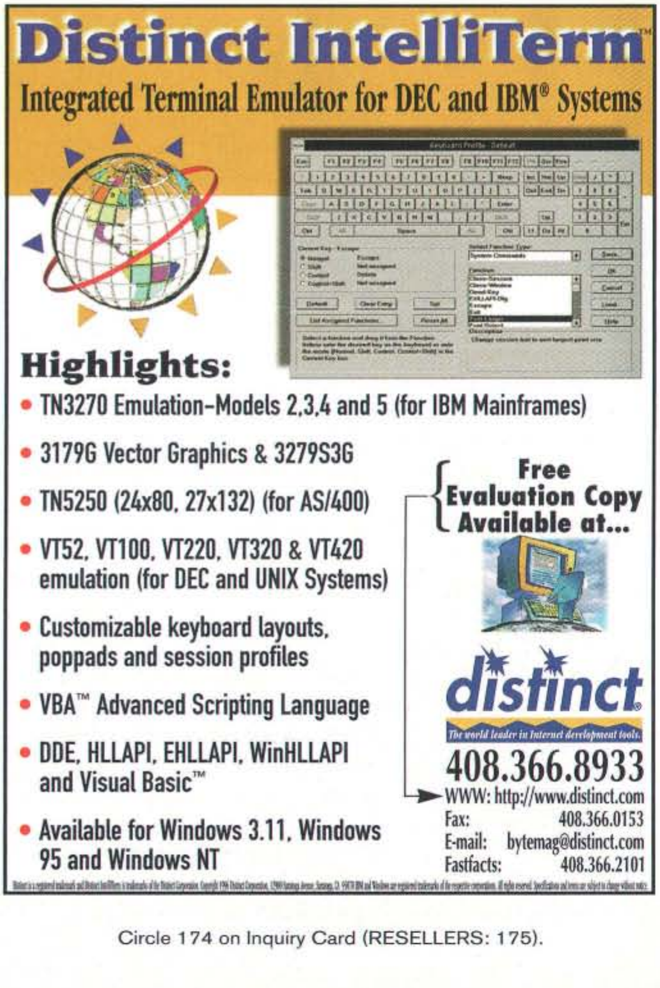
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ter and letting SCSI plus Plug and Play do their things.

The worst of it is that Win 95 doesn't have to assign drive letters to let you access a drive. Network Neighborhood lets you copy to and from a networked drive by name, no drive letter wanted. Unfortunately, most software can't access a drive that way.

The bottom line is that different systems behave in different ways. Mac users are fond of pointing out that they don't have problems like this: their drives have drive names, not letters. It's all true, too.

Following up on last month's disaster: the problem with Cyrus was definitely overheating in the Seagate Barracuda 4.2-GB hard drive. This is a good drive, but everyone I have consulted says you want to be careful about heat.

I learned the hard way. Just after I finished last month's column, it got cool enough in Los Angeles that I shut down the air conditioning. The Santa Ana winds blew up a couple of days later. These are hot winds. The temperature in my office got to 100°F, by which time Cyrus was giving me disk errors every few seconds. When I opened the bezel on the front, the Barracuda drive was so hot I didn't want to touch it.

Leaving the bezel off allowed it to cool down a little, but then the CD-ROM drive wouldn't work: without the bezel in place, no air was being sucked in through the CD-ROM slot. Replacing the bezel fixed the CD-ROM drive (once it cooled down), but then the Barracuda drive overheated again.

Computer designers give a great deal of thought to heat flow, but there's a problem. Openings large enough for good ventilation can leave gaps that will spoil the unit's FCC certification. Moreover, some people, in total defiance of the awful majesty of the FCC, run their systems with the covers off. While that doesn't seem to do much electromagnetic harm—I haven't heard of airplanes crashing or firemen unable to communicate because someone hasn't put the cover on a Pentium system—it does spoil the airflow.

I suspect I had got the wide SCSI cables out of place in one of my excursions into Cyrus. Cyrix has since changed their cable routing scheme because of this problem.

Replacing the Barracuda drive wasn't difficult—the Cyrix case is designed so that everything pulls out through the front and you don't have to disassemble any of the cage—but replacing the drive wasn't a permanent solution to the problem. The airflow around that drive is only adequate at best, and I worried that I'd merely have to displace a cable to cause some more overheating.

One possibility would be more airflow: replace the Cyrix power supply with one from PC Power & Cooling. I'll probably do that before next summer, but for the moment, I needed something less drastic.

After a bit of thought, I got Larry Aldridge to send me a CPU-Cool chip fan. There's just room between the Barracuda drive and the front bezel to attach the fan and run the wire back to an unused drive power jack.

That seems to have done it. Even in the hottest weather, the Barracuda drive is only warm; the CD-ROM drive works fine; and Cyrus has given me no problems at all. I never did have any problems with heat in the box itself.

If you suspect you have temperature problems, or want to be sure you don't, think about getting a PC Power & Cooling CPU-Cool chip fan to cool your hard drive.

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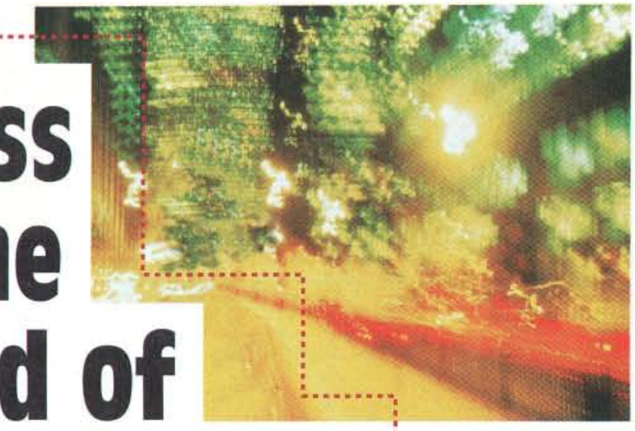

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Replacing your hard drive is no fun.

It was a bit easier for me, because Cyrix preconfigured the drive by installing Win 95 complete with the Plus package before they sent it to me. Once I'd cooled off the original drive, I was able to peel off nearly all the software onto networked drives. The whole operation took less than a day, including all the retry errors until I figured out that I'd overheated the CD-ROM drive.

If you have never used Disk Editor, this is not the time to learn it.

Alas, whoever configured the new drive for me told it that the system belonged to Jerry Pournel of BYTE Mazgne; which meant that when I installed Microsoft Office, it insisted on labeling all my documents that way.

Clearly, something had to be done. Unfortunately, neither Win 95 Help nor any of my numerous books on Win 95 had much information on how to change user names. Even Lenny Bailes's *BYTE Guide to Optimizing Windows*, which tells how to get the Microsoft Windows 95 Easter egg, had little information on it.

I used Gopher to search all my files for the string "Mazgne," and found it in a First Aid safety file. That file can be edited, but editing it does no good at all. Clearly, the string was stored in hexadecimal format, not ASCII.

The books say that a program called REGEDIT.EXE comes with Win 95; it's in the Windows directory. There's not much information about using it, and all the books warn you to be extremely careful. I tried it a couple of times, but I wasn't sure what I was doing, so I never saved any changes I made. However, it became clear that what I wanted was in a hexadecimal file called SYSTEM.DAT.

Eventually, I made two backup copies of SYSTEM.DAT and attacked that file with the Norton Disk Editor. It turned out to be easy enough to find the hexadecimal equivalent of the word *Mazgne*. A bit of study showed how the user and company names are stored, including what is used to terminate the string: it's an 01 followed by blanks (00). I looked up the hexadecimal equivalents of the English letters I wanted, used Disk Editor to fix my name and spell *Magazine* properly, terminated the strings with 01, and all's well.

Fair warning: you edit SYSTEM.DAT at your own risk. It would be very easy to muck up your machine so that you can't boot up Win 95 at all. If you're going to do it, make a backup copy of SYSTEM.DAT. Also, be sure you have a DOS boot disk and a program like Norton Commander that will see hidden system files so that you can boot up in DOS and restore SYSTEM.DAT from a copy.

Next, go to Norton Utilities and Disk Editor. If you have never used Disk Editor, this is *not* the time to learn it. Learn how to use it on game files or other stuff you don't mind losing.

Disk Editor will drop you into DOS mode. Now do OBJECTFILE and browse in the Windows or Windows.000 directory until you find the file SYSTEM.DAT. Let Disk Editor bring that in. Search for the string you noted earlier. It will find it. Note that the end of the string has 01 followed by blanks (00). If you change the length of your string, you *must* terminate it with that 01. Now make your changes by writing in the hexadecimal-number equivalents of the letters you want to insert.

If you have a mouse working (you may not, depending on the AUTOEXEC.BAT and CONFIG.SYS files used to bring up DOS internally), you can go over to the little ASCII interpretation that Disk Editor puts out to the side and make changes there by typing in ASCII letters; be *sure* you are putting them exactly where you think you are, and that this is where they are supposed to be. It's easy to make mistakes here.

Do it right. You can make the user Elmer P. Fudd and the company The Acme Corp., or whatever you like. When you have everything exactly the way you want it, with 01 as the last character in each string, exit Disk Editor with the save option.

Windows will come up. It will see that the date of the SYSTEM.DAT file has changed and will be unhappy. It will offer you the choice of proceeding even though it doesn't like to. Do that, and when it comes up properly, Bob's your uncle.

If all doesn't go well, boot up in DOS, copy the saved file back to SYSTEM.DAT, and start over. Good luck.

Some months are just a series of disasters. Fortunately, many disasters are instructive.

The other day, Niven came over to work on our new book. He usually works with an elderly Cheetah 486 upgraded with

Intel's Pentium OverDrive. That system runs NT 3.51 because we haven't got around to installing version 4.0 yet. In a burst of zeal, I had attempted to dismantle that system and put in something faster for Larry, mostly for games, since the system is plenty fast enough when running Word. I'd got as far as unplugging things when I ran out of time; so when Larry came over, I plugged things back in.

The result was that every time we put Word on full-screen, the machine screamed at me. When we'd minimize Word, the screaming stopped. I wasn't thinking too clearly: I assumed it was the machine itself. I turned it off and attempted to move Cyrus, which sits on a portable stand, over to where Larry could use it.

This led to disaster: Cyrus, still running, fell about 3 feet to the floor. The bezels popped off the front, and the CPU-Cool chip fan I'd attached to the Barracuda hard drive hung out the front looking for all the world like an eyeball popped out of its socket. It really looked bad.

I turned the machine off, and we went to dinner. When we got back, I tried it: no horrible noises, no blue smoke, but no video either. I put in a frantic call to Alex, who came over to help do a systematic checkup.

First things first: try a new video board. Still no video. Next, remove all the boards except the new video board.

Voilà! The machine booted up, and, astoundingly, a surface scan revealed absolutely no problems with the hard drive. I still can't get over that. The SCSI Zip drive, which had sat on top of Cyrus and thus fell even further than he did, also worked just fine.

The next step was to install the boards one by one. We soon found that the problem was the Creative Labs AWE32 CT-3600 sound board. Close inspection didn't show anything wrong with the board, but when it was in the system, Cyrus wouldn't boot. One of these days, I'll ship it back to Creative Labs and let them try to figure out what's wrong. I sure can't.

Fortunately, I had another AWE32 board. Unlike the CT-3600, this one had an IDE controller for a CD-ROM drive. That meant it needed another interrupt request (IRQ), and while it was supposed to be Plug and Play, it wasn't. Win 95 insisted on assigning it almost anything except IRQ 5, but far too many DOS games are hard-coded to expect the sound board at IRQ 5. Eventually, we got the sound board set to IRQ 5 and installed a new SupraExpress 336 Sp with Analog Simultaneous Voice and Data (ASVD) internal modem. For some incomprehensible reason, Win 95 wanted to assign that to IRQ 15. You can't do that.

We spelunked into Device Manager. Deep in that well, we found a way to configure the modem to "Configuration 000002," which assigns it to share COM1.

It all works just fine now. The SupraExpress is as good an internal modem as you'll find. It works with all the terminal and fax programs I have. I still mildly prefer external modems, because you can sometimes get into a situation in which the easiest way to reset the modem is to turn it off. I wish modem companies would put a little Reset button on the back. In fact, though, I haven't recently had to reset the modem at all, and I sure can't complain

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about the SupraExpress's performance. It is fast, locks on through lots of line noise, and just plain works. Recommended.

As to why the Cheetah was screaming at us, when I plugged things back in, I managed to plug the 21-inch Hitachi monitor into the wrong uninterruptible power supply (UPS). That didn't *quite* overload the UPS, but when we brought up Word, with a big expanse of white screen, that required just enough more power that it triggered the UPS's overload warning. Closing Word or reducing the white-screen size would reduce the power requirements just enough. Silly, but maddening if you're in a hurry and don't think things through.

The Cyrix system comes with a Matrox MGA Millennium, which is a very good video board indeed. However, after we dropped Cyrus on his head and weren't getting any video, we changed boards. That didn't turn out to be the problem—the Matrox board works just fine—but it did give us the opportunity to test the new Orchid Fahrenheit Video 3D board.

That sucker screams. It does 2-D and 3-D movies really fast and really pretty. You can't believe how smoothly Duke Nukem, Doom, and Quake scroll.

Most of my work with computers involves words and text, and, except for games like Doom, I honestly can't tell the difference between the Matrox, Diamond, and Orchid boards. They all show 2-D graphics in good resolution with steady pictures and high contrast. That doesn't mean there aren't any differences, or that they won't be noticed by people doing graphics work. I've arranged for David Em to test our graphics boards on the Doubleshot 133. David does really complex graphic art and works these systems as hard as anyone can.

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The shareware of the month is Visual DialogScript. This is a scripting language, the successor to WinScript. You can use it to create all kinds of Windows dialog boxes and controls, some very elaborate. It comes with both text and icon editors. An example of Visual DialogScript in use: a program applet that lets you browse through files and change their time and

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You can find out more from jmtech @netlink.co.uk, or you can download Visual DialogScript from http://www.netlink .co.uk/users/jmtech, or the CompuServe WINUTIL and WINSHARE forums.

The book of the month is John Keegan's *Fields of Battle: The Wars for North America*. Like all Keegan's books, this is both readable and insightful. Fair warning: this is not an introductory work. You need passing familiarity with the American Revolution and the Civil War. I have one quarrel: Keegan goes to great lengths to tell why geography has dominated the wars on this continent—but the book has almost no maps. To properly appreciate this book, you need a good historical atlas.

The computer book of the month is Ned Snell's *Navigating the Microsoft Network*. It includes a copy of Microsoft Internet Explorer and goes into interesting detail about tuning your computer, what you'll find on the Internet, and some tricks of the trade. Most Internet books are out of date by the time they're published; this one is probably good for a year or so.

The game of the month is Strategic Simulations' The Age of Rifles. A DOS game, it plays well in Win 95. It's a turn-based tactical/strategic game with scenarios from just after the Napoleonic Wars to the turn of this century, including the American Civil War. The dominant fact of the age of rifles was that unlike muskets, rifles had effective ranges right up with artillery; well-dug-in riflemen could pick off the gunners faster than the gunners could return their fire. That's not always obvious in this game. It's still a lot of fun.

I'm heading overseas at the end of this month, so next month I should have some observations about computing in Europe, as well as a lot of data about graphics hardware and programs. **B**

Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please include a self-addressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at **jerryp@bix.com**.

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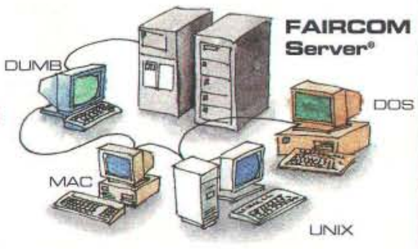

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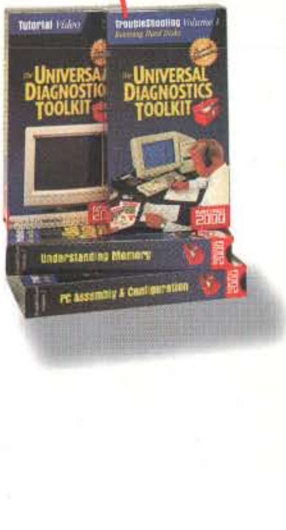
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Epson 8000, 1800, 4000, 4100, 4300	–	–	89	–	173	–	–	272	–	–	–	–
Epson 1000, 1500, 5000, 5200	–	–	–	89	–	–	179	–	–	–	–	–
HP 2, 2D–	–	–	–	69	–	–	99	–	–	–	–	–
HP 3, 3D, 3P, 2P 2P+	–	–	–	***69***	–	–	***99***	–	–	–	–	–
HP 4, 4M, 4SI, 4SIMX	–	–	–	49	–	–	59	–	–	99	–	–
HP 4P, 4PLUS, 4MPm 1600, 1600CM	–	–	19	29	–	–	49	–	–	89	–	–
HP 4L	–	–	34	–	–	–	–	–	–	–	–	–
HP 3SI	–	–	39	–	–	–	69	–	–	99	–	–
HP 5L	–	–	49	74	–	–	89	–	–	199	–	–
HP 5P, 5MP, 4V, 4MV	–	–	19	39	–	–	49	–	–	89	124	–
HP Design Jet 600, 650, 200	–	–	–	39	–	–	49	–	–	89	139	239
HP Deskjet 500, 500C, 510, 550,560	–	***34***	–	–	–	–	–	–	–	–	–	–
HP Deskjet 1200C, 1200C/P	–	–	–	39	–	–	49	–	–	89	–	–
HP Paintjet XL300	54	–	–	–	–	–	69	–	–	144	299	–
IBM Laser 4019, 4019E	–	–	–	–	–	139	–	–	–	–	–	–
IBM Laser 4029, 4037	–	–	–	–	–	–	89	–	–	–	–	–
IBM Laser 4039, 4079	–	–	–	***69***	–	–	***89***	–	–	***189***	–	–
Konica LP-3110, 3115	–	–	119	189	239	–	–	–	–	–	–	–
Lexmark Medley 4C, 4x, 4SX	–	–	Call	Call	Call	–	–	–	–	–	–	–
Lexmark, Optra L, LX, R, RX	–	–	–	–	–	–	59	–	–	94	139	259
Lexmark Valuwriter 300,600	–	–	29	39	–	–	89	–	–	–	–	–
Lexmark Winwriter 200, 400, 600	–	–	29	39	–	–	89	–	–	–	–	–
NEC 90, 290	–	–	–	89	–	–	–	–	–	–	–	–
NEC 95, 97	–	–	–	79	–	–	–	–	–	–	–	–
Oki 400	–	–	–	79	–	–	–	–	–	–	–	–
Oki 400E, 400EX, 410E, 410EX	–	–	89	109	169	–	189	–	–	–	–	–
Oki 810E, EX, 600E, EX, 610E, EX	–	–	29	39	–	–	79	–	–	119	179	–
Oki 830, 840	–	–	–	89	–	–	–	–	–	–	–	–
Oki 2350, 2450	–	–	Call	Call	–	–	–	–	–	–	–	–
Packard Bell PB 9500	–	–	–	139	–	–	227	–	–	–	–	–
Packard Bell 9815	–	–	–	139	–	–	229	–	–	–	–	–
Panasonic 4420/4450I	–	–	–	99	–	–	169	–	–	–	–	–
Panasonic 4418/4430	–	–	–	***89***	–	–	***129***	–	–	–	–	–
Panasonic 4450	–	–	89	–	–	–	–	–	–	–	–	–
Panasonic 4400/5400	–	–	89	99	–	–	189	–	–	–	–	–
Panasonic 4440, 5410, 6500	–	–	79	99	–	–	159	–	–	–	–	–
Sharp 9400, 9460, 9600, 9700E	–	–	69	99	–	–	149	–	–	–	–	–
Sharp 9500, E, H, 9700, H	–	–	79	–	–	–	259	–	–	–	–	–
TI XL/PS17/PS35	–	–	49	–	–	–	–	–	–	–	–	–
TI Microlaser Pro E, Powerpro, Pro 600	–	–	89	129	–	–	189	–	–	329	–	–
TI Microwriter	–	–	79	119	–	–	–	–	–	–	–	–

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Tecra 500/P650	***8Meg/16Meg/32Meg/48Meg/128Meg***		***119/239/459/Call/Call***
Tecra 700 (SDRAM)	***8Meg/16Meg/32Meg***		***119/259/429***
Tecra 710, 720	***8Meg/16Meg/32Meg/64Meg/128Meg***		***119/259/429/Call/Call***
T2000SXE/2200SX/T1800, 1850, C	8Meg	PC-PA2000U	94.00
T2100, 2105, 2150, 2155, 2110, 2115	4Meg/8Meg/16Meg/24 Meg		69/89/169/229
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	4Meg	PC-PA2012U	69.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	8Meg	PC-PA2013U	79.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	16Meg/32Meg	PC-PA2014U	159/279
T3400CT, T2400, T3600	4Meg/8Meg/16Meg/24Meg	PC-PA2019U	89/119/179/Call
T100, 105, 110, 115	***8Meg/16Meg/32Meg***		***119/189/319***
T400, 405, 410, 415, 420, 425	***8Meg/16Meg/32Meg***		***119/189/319***
T400CS, 400CDT, T100, 105 Edo	***8Meg/16Meg/32Meg***		***119/189/319***
T600, 610, CT Edo	8Meg/16Meg/32Meg		119/189/319

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
ACERNote 730C, 735C, 760C, 760CX, 780CX	2Meg/4Meg/8Meg		49/69/99
ACERNote 763, 765, 782, 784, 786	4Meg/8Meg/16Meg		59/79/159
ACERNote Light 350, 352, 355	4Meg/8Meg/16Meg		69/99/169
ACERNote Light 356, 358, 359, 361 (pairs)	4Meg/8Meg/16Meg		69/99/189
ACERNote Pro 950, 954, 955, 957, 959 (pairs)	4Meg/8Meg/16Meg		79/109/189
Ambra N Series	***4Meg/8Meg/12Meg/16 Meg***		***89/109/139/189***
Ambra SN Series	4Meg/16 Meg		79/179
Ambra N-75, N-100	4Meg/8/16		49/89/169
AST Ascentia P30, P50	***8Meg/16Meg/32Meg***		***89/189/309***
AST Ascentia J10, J30, J50	***8Meg/16Meg/32Meg/40Meg Kit***		***99/189/Call/Call***
AST Ascentia 900N, 800N, 810, 910	8Meg/16Meg		99/189
AST Ascentia 950	8Meg/16Meg		99/189
AST Bravo & Explorer	***4Meg/16Meg***	***501255-001, -002***	***79/219***
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	69.00
AST Power Exec 3/25C, 425EL, 425SL	4Meg/16Meg	501166-001, -003	79/189
AST Power Exec 4/33SL	4Meg/16Meg	501318-001,002	79/189
AT&T Globalyst 130, 200, 250	4Meg/8Meg/16Meg		69/99/149
Austin DX4, DX2, SX2, SX Series	4Meg/16Meg		79/219
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CTX EZ Book 5x86 Pent, Series	***4Meg/8Meg/16Meg***		***Call***
DEC HiNote, Ultra HiNote	4Meg/8Meg/16Meg		69/109/189
DEC HiNote VP	***8Meg/16Meg/32Meg***		***89/189/299***
Dell Latitude LM (pairs)	***4Meg/8Meg/16Meg***		***69/99/189***
Dell Latitude 433, C, CX	4Meg/16Meg		79/199
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Dell Latitude LX, M	4Meg/8Meg/16Meg		79/119/199
Dell Latitude XP, XPi	4 Meg/8Meg/16 Meg		79/119/199
Epson ActionNote 650, 650c, 660c, 660cx	4Meg/8Meg/16Meg		69/109/189
Epson ActionNote 700, 700c, 700cx	4Meg/16Meg		79/189
Epson ActionNote 880, 866c, 890	4Meg/8Meg/16Meg/20Meg		59/89/159/199
Epson ActionNote 4LC/25, 4LC/33, 4SLC/2-50, 4000	6Meg		79.00
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Hitachi M-Series	***8Meg/16Meg/32Meg***		***129/249/516***
HP Omnibook 300, 480, 425	2Meg/4Meg		83/129
HP Omnibook 530, 600	4Meg/8Meg/12Meg		69/89/149
HP Omnibook 4000	4Meg/8Meg/16Meg		69/89/169
HP Omnibook 5000	8Meg/16Meg/32Meg		89/169/319
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Tandy 2820, 3820, 3830	2Meg/4Meg/6 Meg		65/99/135
Tulip, all models	***4Meg/8Meg/16Meg/32Meg/64Meg***		***Call***
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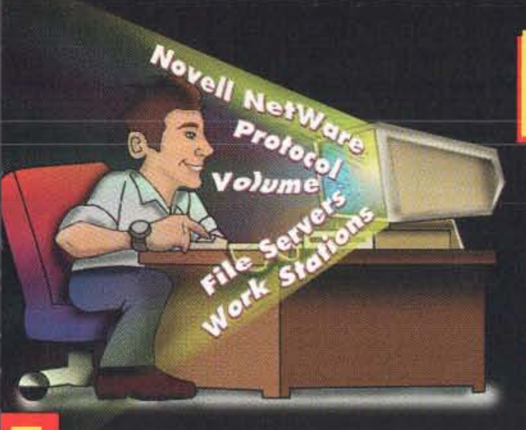

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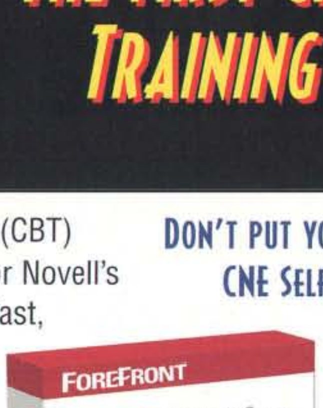
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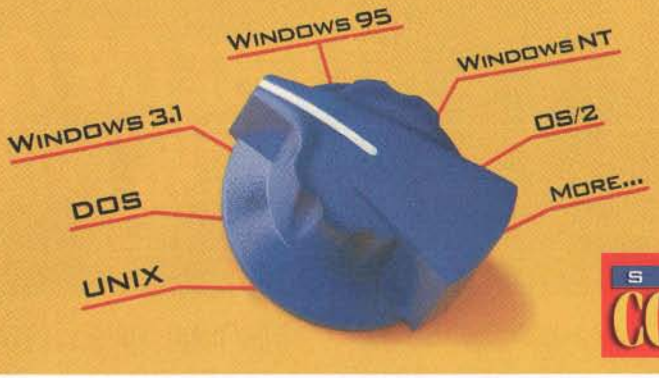

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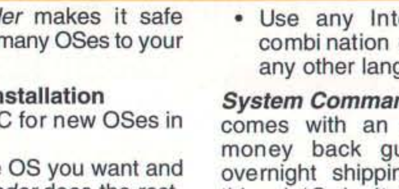

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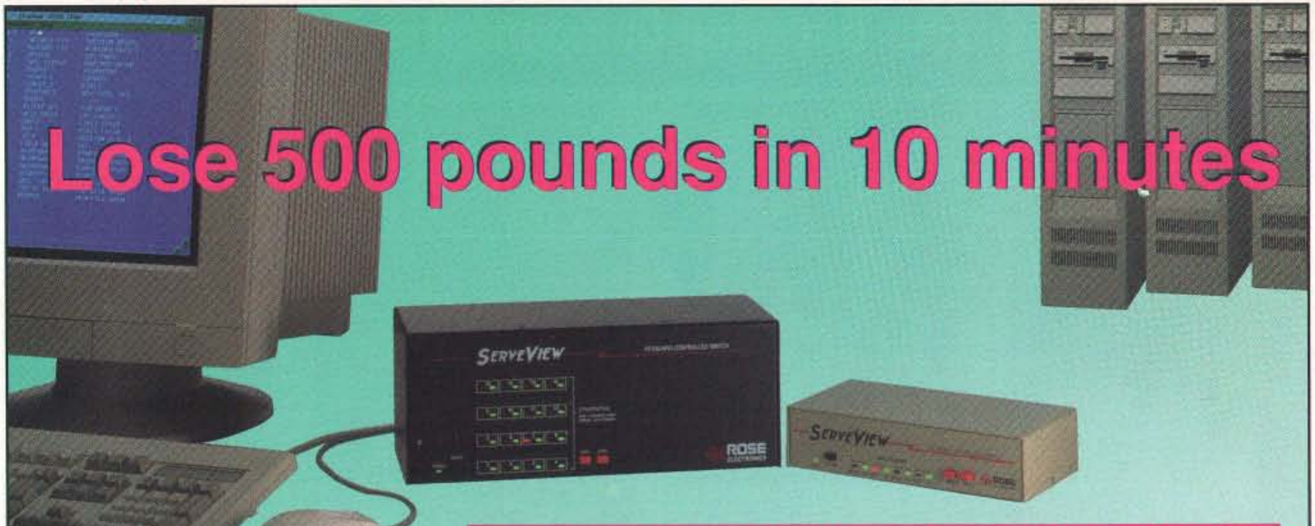

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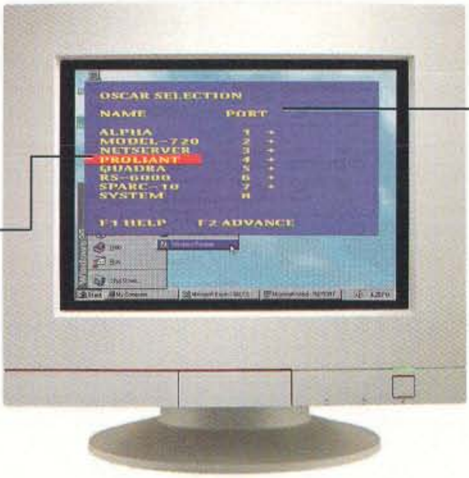

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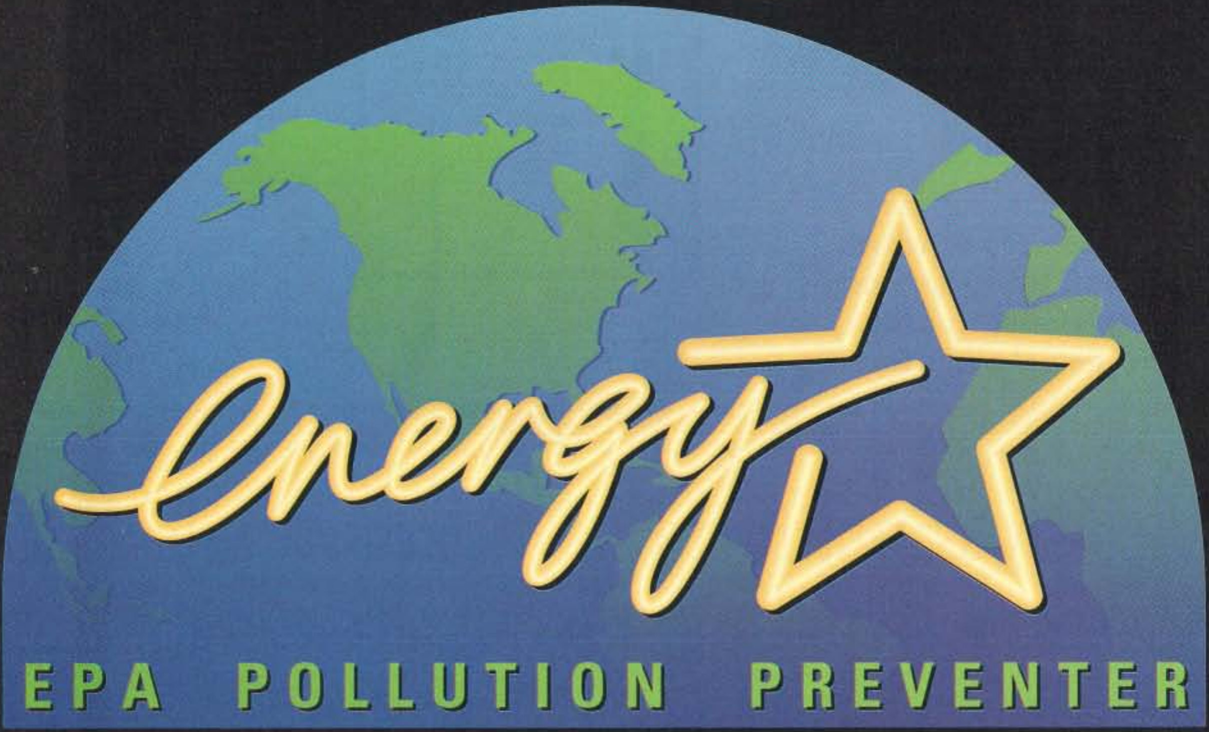

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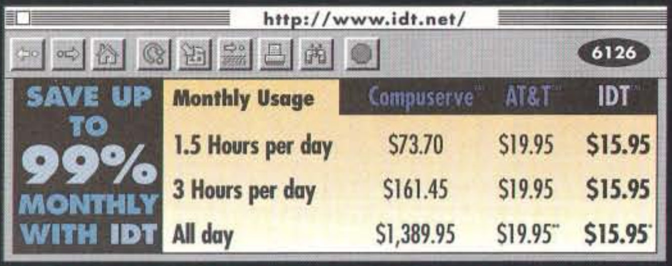

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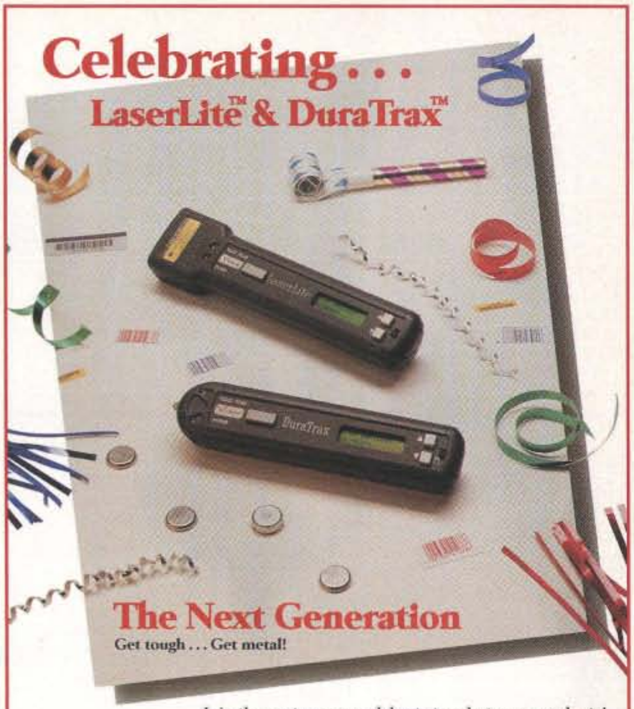

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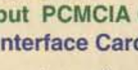

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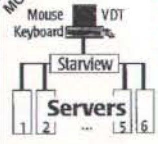

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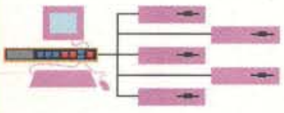

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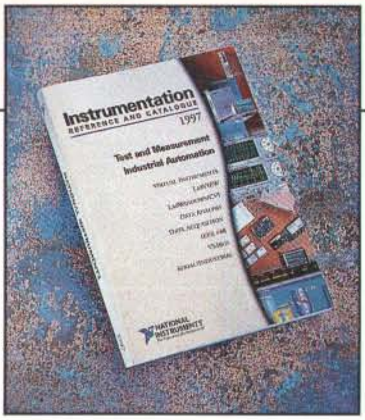

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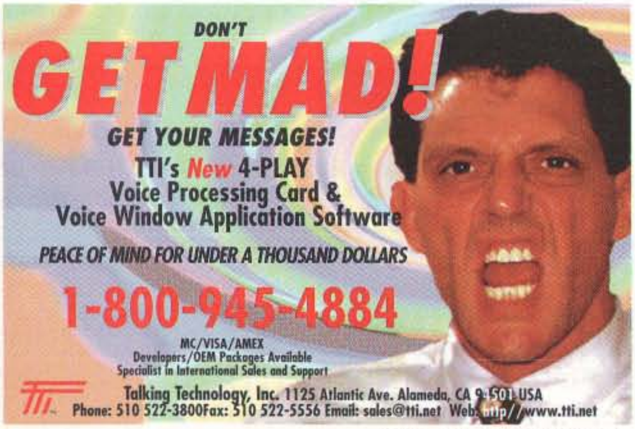

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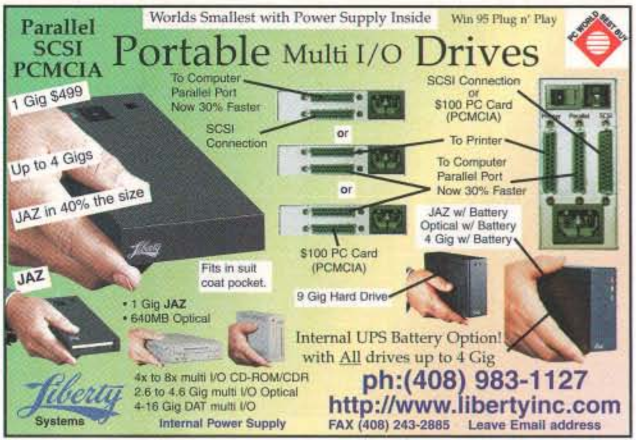
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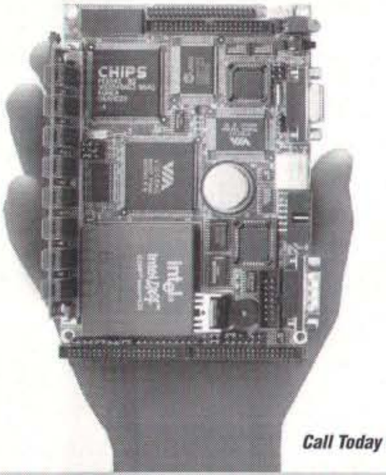

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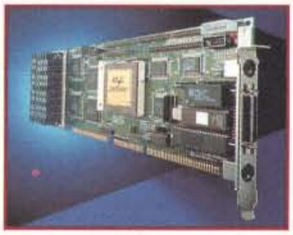

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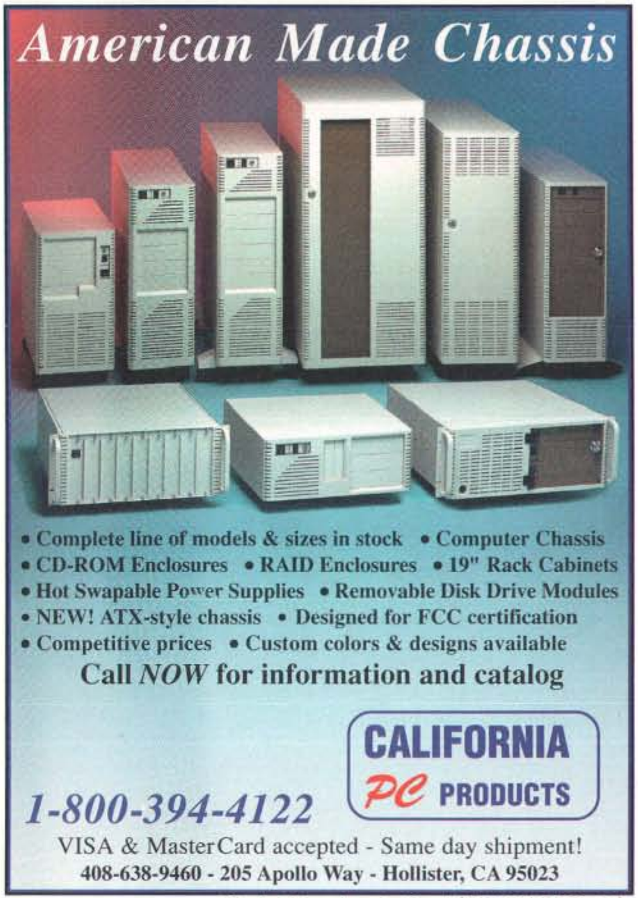

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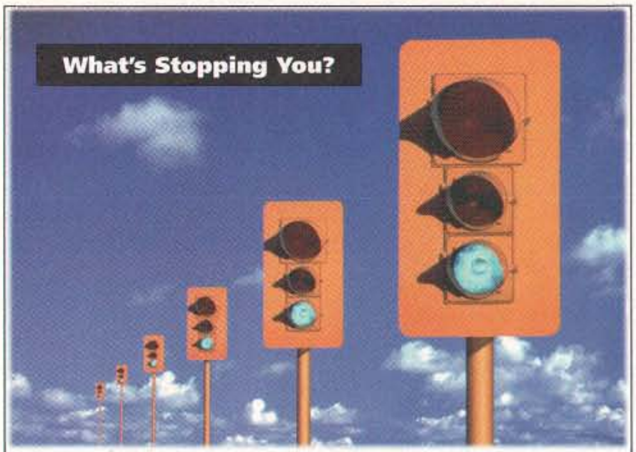

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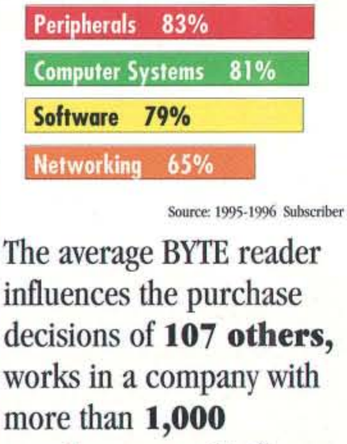

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124	DUNN SYSTEMS	171	800-486-DUNN ext 405
	E		
706-707	EUTRON	40IS 12	+39 35 201003
731-732	EXABYTE EUROPE	40IS 27	+31 20 254 0090
	F		
720-721	F & H SIMULATIONS	15	+31 13 5427 516**
222	FAIRCOM CORPORATION	147	573-445-6833
708-709	FAST SECURITY AG	40IS 5	+49-89-894221-20
170-171	FINSON	62	+39-2-6698-7036
727-728	FIRST INTERNATIONAL COMPUTER	40IS 2	+886-2-718-2782**
202-203	FIRST SOURCE INT'L	153	714-448-7750
211	FOREFRONT DIRECT INC	157	800-653-4933
196	FORTRES GRAND CORPORATION	39	800-331-0372
	G		
108	GAGE APPLIED SCIENCES INC	167	800-567-GAGE ext 3425
184	GLOBETROTTER SOFTWARE INC	75	408-370-2800
212-213	GRANITE DIGITAL	158	510-471-6442
710	GREY MATTER LTD	37	+44-(0)1364-654200**
729-730	GVC	CV	+886-2-704-0338**
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125-126	HIWAY TECHNOLOGIES	172	800-339-HWAY
	I		
93-94	ICP ACQUIRE	167	888-618-6188
*	IDT INTERNET	165	800-689-9438
231	INTEGRIX INC	96	800-300-8288
141-142	INTERGRAPH COMPUTER SYSTEMS	51	800-763-0242
165-166	IQ SOFTWARE	8-9	800-458-0386
	J		
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226-227	LA TRADE	156	310-539-5844**
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95	LIBERTY SYSTEM INC	168	408-983-1127
711	LOGIC PROGRAMMING ASSOCIATES	40IS 26	800-949-7567
	M		
*	MCGRAW HILL ON LINE	40IS 27	
210	MICRO 2000	150-151	818-547-0397**
204-205	MICRO SOLUTIONS COMP PROD	155	800-295-1214
*	MICRO-INTERNATIONAL INC	169	800-967-5667
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161	MICRON ELECTRONICS	72-73	800-723-2998
162	MICRON ELECTRONICS	CII-1	800-362-7306
*	MICROWAY	131	508-746-7341
145	MINITAB INC	35	814-238-3280
712-713	MINOLTA GMBH	40IS 11	+49-511-7404-401
725-726	MITAC	95	+886-2-501-4265**
	N		
109	NATIONAL INSTRUMENTS	167	800-433-3488
102	NEATO	170	800-984-9800
235	NSTL	140	610-941-9600
	O		
*	ON TIME MARKETING	40IS 16	+49-40-227-9405
*	OSBORNE MCGRAW-HILL	182-183	800-822-8158
	P		
*	PAAM '97	122	+44-0-1253-35-8081
715	PERSOFT INC	40IS 19	800-368-5283
185-186	PHILIPS BUSINESS ELECTRONICS	77	800-835-3506
146-147	PINNACLE MICRO	7	714-789-3000
739-740	PK ELECTRONICS	40IS 10	+60-6-677-2993
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182	POWERQUEST	2-3	800-379-2566
223	POWERSOFT OPTIMA	29	800-395-3525
741	PRIME ELECTRONICE TRADING GMBH	40IS 20	+49-40-484080
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105	QUALSTAR CORP	169	800-468-0680
82-83	QUATECH INC	166	800-553-1170
	R		
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180-181	RAIDTEC CORPORATION	146	770-664-6066
716-717	RAIMA CORP	40IS 15	206-557-0200
228	RAINBOW TECHNOLOGIES	61	714-450-7300
88-89	RCI	167	800-RCI-8090 ext 71
115-116	RECORTEC INC	169	888-RECORTEC
207-208	ROSE ELECTRONICS	160	800-333-9343
150-151	ROSS TECHNOLOGY INC	93	800-ROSS-YES
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218-219	SHARK MULTIMEDIA	165	800-800-3321
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First Last

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Company ______________________________

Address ______________________________

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A. Business/Industry: (Check one)

1 ☐ System Integrator, VAR, Computer Service Bureau, Software Planning & Consulting Service
2 ☐ Manufacturer (other than computer)
3 ☐ Finance/Insurance/Real Estate
4 ☐ Education/Medical/Law
5 ☐ Business Service
6 ☐ Manufacturer of Computers, Data Systems Hardware or Peripherals (OEM)
7 ☐ Government: Federal/State/Local
8 ☐ Public Utilities, Communications Systems or Transportation Systems
9 ☐ Wholesale/Retail/Trade
10 ☐ Other (Please specify): __________

B. Title/Function: (Check one)

11 ☐ Senior Company Management
12 ☐ Senior IS/IT Management
13 ☐ IS/IT Management
14 ☐ Application Development/Integration
15 ☐ Technical Support Services
16 ☐ Operations/Manufacturing
17 ☐ Systems/Networking
18 ☐ Systems Engineering/Integration
19 ☐ Department Management (non-IS/MIS)
20 ☐ Consulting
21 ☐ Other (Please specify): __________

C. Do you evaluate, specify, recommend, purchase: (Check all that apply)

22 ☐ Application Development Products
23 ☐ Networking/Communication Products
24 ☐ Operating Systems
25 ☐ Large Systems (Mainframes/Minis)
26 ☐ Desktops (Micro's/Workstations)
27 ☐ Systems Software Products
28 ☐ Application Software Products
29 ☐ Peripheral Equipment
30 ☐ Telecommunications Services

D. How many people are employed at this location and your entire organization:

At this location		Entire Organization
31 ☐	10,000+	37 ☐
32 ☐	5,000-9,999	38 ☐
33 ☐	1,000-4,999	39 ☐
34 ☐	500-999	40 ☐
35 ☐	100-499	41 ☐
36 ☐	Under 100	42 ☐

E. What is the scope of your purchase involvement?

43 ☐ Company wide
44 ☐ Division wide
45 ☐ Department wide
46 ☐ Individual

January 1997

90 97 99

Valid until March 31, 1997

Advertiser Inquiry Numbers

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Accessories/Supplies	1
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Bar Coding	3
Communications	4
Computer Telephony	60
Data Acquisition	6
Desktops	5
Diagnostic Equipment	53
Disk Drives	7
Fax Boards/Machines	9
Industrial Computers	76
Input Devices	10
Laptops & Notebooks	13
Mass Storage	23
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Monitors & Terminals	18
Multimedia/CD-ROM	19
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Optical Drives	65
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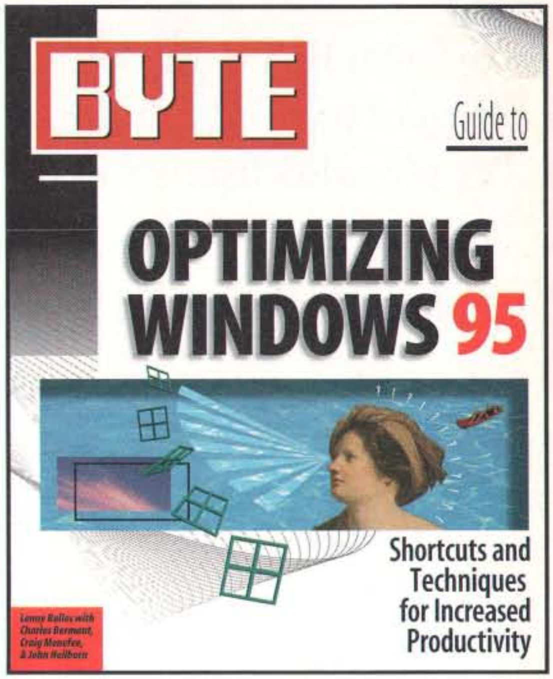
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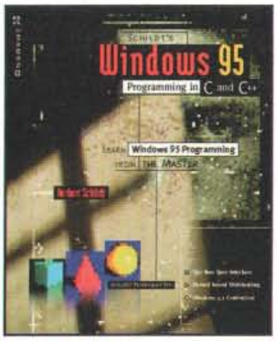

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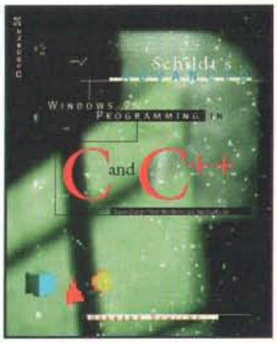

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PH: 617-273-2919
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FAX: 216-742-3145

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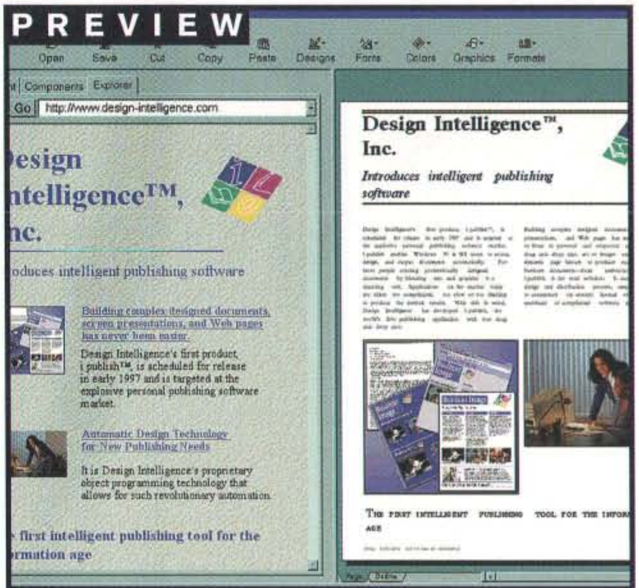
What's New



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Publish Dynamic Documents

Producing good-looking documents can be a struggle, which is why design templates and Wizards are a popular way to guide nondesigners through the process of turning ideas into compelling proposals and reports. A new program for Windows 95, called i-publish, seeks to improve on this process.

The i-publish program (which is slated to ship in the second quarter of this year) offers templates for all sorts of documents. But what sets it apart is its built-in intelligence. Rather than using the static approach that most programs offer, i-publish templates dynamically change as you assemble content. For example, as you drop photos, text, or other content into template "frames," i-publish automatically fits information such as captions and headlines, doing the resizing and reformatting as you go.

In addition, the expertise built into the program ensures that all the elements relate to each other as you add or delete information. And the program is smart enough to reformat a document for different applications. For example, if you create a newsletter for print and tell i-publish you want to post it on the Web, it will automatically put in Web-appropriate bullets and create necessary links.

You can engage in all sorts of what-if scenarios (e.g., changing fonts and colors), and i-publish will adjust everything else in the document so the overall look remains professional and balanced.

–Jon Pepper

Business

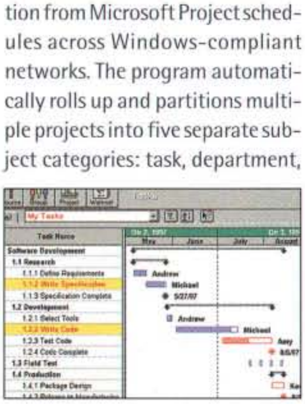
Text and Numbers Become High-Impact Visuals

A COMPANION TO MICROSOFT OFFICE, ActiveOffice (about $50) lets you highlight specific numbers or sections of text in a document, click once in the ActiveOffice Gallery, and transform those numbers and/or words into visual elements for presentations.

Contact: Software Publishing Corp., San Jose, CA, (800) 336-8360 or (408) 537-3000; http://www.spco.com.
Circle 1003 on Inquiry Card.

Customize Project Status

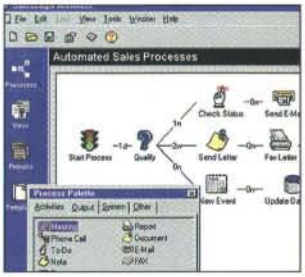
WITH SCHEDULE INSIGHT ($189), YOU CAN view personalized status information from Microsoft Project schedules across Windows-compliant networks. The program automatically rolls up and partitions multiple projects into five separate subject categories: task, department, project, individual, and company. You can view all items of a subject at once in spreadsheet format or just focus on a particular item.



Contact: Kalyn Corp., Los Altos, CA, (800) 595-2596 or (415) 948-5124; http://www.kalyn.com.
Circle 1004 on Inquiry Card.

Sales Automation

THE SALESLOGIX SALES INFORMATION SYSTEM offers contact, account, and opportunity management; group scheduling; territory management; word processing; printing to paper-based organizers; forecasting; custom and built-in reporting; a client/server database; and an online Sales Encyclopedia. The Client component, for remote, network, or stand-alone use, costs $395; the Workgroup Client component, designed for network use only, is $295. Also available are Mobile Connection ($295), Information Server ($995), and Synchronization Server ($995) components.



Contact: SalesLogix Corp., Scottsdale, AZ, (888) 643-6400 or (602) 368-3700; http://www.saleslogix.com.
Circle 1005 on Inquiry Card.

Thrive in a Diverse Workplace

DESIGNED FOR ORGANIZATIONS ADJUSTING to an increasingly diverse work force and the globalization of business, No Potential Lost consists of three CD-ROMs (set, $4500; individual CD-ROMs, $1595 each). This

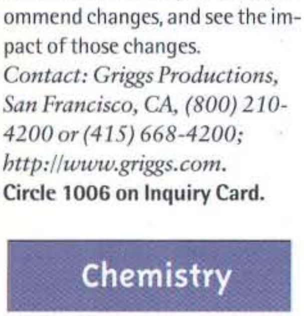
We preview Design Intelligence's i-publish, a program for producing professional-looking documents; and the Tektronix Phaser 350, a color ink-jet printer.

training program helps you to establish a foundation for successful interaction and personal fulfillment; shows you examples of energy-depleting and energy-enhancing actions; and enables you to assess situations at an organization, identify any problems, recommend changes, and see the impact of those changes.
Contact: Griggs Productions, San Francisco, CA, (800) 210-4200 or (415) 668-4200; http://www.griggs.com.
Circle 1006 on Inquiry Card.

Chemistry

Add Chromatographic Data to Documents

NOW YOU CAN INSERT CHROMATOGRAPHIC data into word processors, spreadsheets, and database files as OLE objects. Running under Windows 95 or NT, ChromKeeper ($99) also lets you edit the chromatograms inside reports, presentations, or papers; magnify or crop out specific peaks in a chromatogram; edit headers and footers; and change font sizes, styles, and colors.
Contact: SoftShell International, Ltd., Grand Junction, CO, (970) 242-7502; http://www.softshell.com.
Circle 1007 on Inquiry Card.



Macintosh

Visual Modeling

ANALYTICA FOR THE MAC ($795) SIMPLIFIES model development, maintenance, and communications. The program's object-oriented diagrams, which contain bubbles and links, highlight key relationships between model variables. Intelligent Arrays let you add or retract dimensions, such as time periods, product lines, geographic regions, and alternative plans, with minimal changes to the model structure. Integrated risk and sensitivity analysis aids modeling situations with uncertain factors.
Contact: Decisioneering, Inc., Denver, CO, (800) 289-2550 or (303) 534-1515; http://www.decisioneering.com/.
Circle 1008 on Inquiry Card.

Networking

Virtual IP Internet Gateway for NetWare

WITH VIRTUAL IP INTERNET GATEWAY FOR NetWare (five-user license, $1055), network administrators can troubleshoot, manage, control, and analyze users' access to intranet resources and the Internet. The program provides firewall protection at the server level and allows for a secondary server, which monitors the primary server's status. If the primary server fails, the secondary server automatically becomes active.
Contact: FTP Software, Inc., Andover, MA, (800) 282-4387 or (508) 685-3300; http://www.ftp.com.
Circle 1011 on Inquiry Card.

Manage NLMs

CONFIG CENTRAL (10-SERVER STARTER pack, $499), which supports NetWare 3.12 and 4.1, snaps into Novell's Managewise and NWAdmin to minimize the time you have to spend managing and troubleshooting NLMs. The program highlights unexpected or problem NLMs and lets you remotely edit NCF files.
Contact: NetPro Computing, Inc., Scottsdale, AZ, (800) 998-5090 or (602) 941-3600; http://www.netpro.com.
Circle 1009 on Inquiry Card.

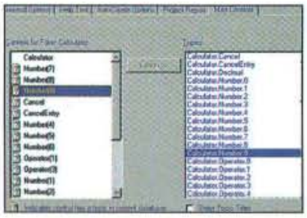
Network Security, Management Suite

MCAFEE ENTERPRISE (SITE LICENSE PER node for 1000 nodes, $125) bridges the gap between NetWare print- and file-server LANs and Unix database- and application-server WANs with a Windows NT–based view of the enterprise. The 10 modules included with the package share a common user interface, data dictionary, scripting language, reporting, messaging, and communications protocols. McAfee Enterprise also integrates firewall, encryption, authentication, and antivirus protection under a centralized management console.
Contact: McAfee, Santa Clara, CA, (408) 988-3832; http://www.mcafee.com.
Circle 1010 on Inquiry Card.

Programming

Build Help Files from VB Projects

FOREVB ($89) LETS YOU CREATE HELP TOPICS that link to specific controls and forms in a user's Visual Basic project and create help files when you set up your forms from within Visual Basic. Alternatively, ForeVB can scan your entire project and create an outline help file. The ForeHelp VB Pack ($449) bundles ForeVB and the ForeHelp Help Authoring System, which provides an environment for adding additional WinHelp features to help files and instant WinHelp simulation and testing.
Contact: ForeFront, Inc., Boulder, CO, (800) 357-8507 or (303) 499-9181; http://www.ff.com.
Circle 1012 on Inquiry Card.



Object-Oriented Ada Development

WITH OBJECTADA FOR WINDOWS AND ObjectAda for Unix, you can develop complex technical applications, link Ada code with C++ applications and vice versa, and develop Internet applications by generating Java byte code. ObjectAda for Windows (Personal Edition, $245; Professional Edition, $595; Enterprise Edition, minimum five copies, $1495 per copy) includes the full Ada 95 core language and annex-

es, a visual GUI builder, Win32 bindings, Winsock TCP/IP bindings, a Visual Ada source browser, WinDbg/Codeview Multilingual Debug, and DLL import and export. ObjectAda for Unix ($8000) features an Ada 95 compiler for Hewlett-Packard and Sun workstations, a debugger, a syntactic editor, and a browser.
Contact: Thomson Software Products, San Diego, CA, (800) 833-0085 or (619) 457-2700; http://www.thomsoft.com.
Circle 1013 on Inquiry Card.

Intranet Development Framework

The tools included with Salvo Vista (10 concurrent users, from US$7250) help developers build Web applications. The four tools specify rules; provide access-control management, object-level security, and impact analysis; control the presentation of information to users; and provide identification of active rules, information on current states, invocation history, and time-stamped data.
Contact: Simware, Inc., Ottawa, Ontario, Canada, (800) 267-9991 or (613) 727-1779; http://www.simware.com/salvo.
Circle 1014 on Inquiry Card.

The Web

Audio E-Mail

A Windows 95–style task bar, Midisoft Sound Bar ($29.95) contains icons for point-and-click access to PC sound capabilities, such as volume, bass, treble, and balance, from the monitor desktop. You can record voice e-mail messages, to which you can add music and sound from Sound Bar's 14 MB of sound and music files. The package includes AT&T's WorldNet Service Internet-access software, two user licenses, and a Labtec AM-32 microphone, which plugs into your PC's sound card.
Contact: Midisoft Corp., Bellevue, WA, (800) 776-6434 or (206) 391-3610; http://www.midisoft.com.
Circle 1015 on Inquiry Card.

Software Updates

A browser add-on that lets you translate Spanish, French, or German Internet sites into English and vice versa, **Globalink Web Translator 1.1** supports Microsoft's Internet Explorer 3.0 and includes a Dictionary Editor, which lets you add new terms. $49.95.
Contact: Globalink, Inc., Fairfax, VA, (800) 255-5660 or (703) 273-5600; http://www.globalink.com.
Circle 1018 on Inquiry Card.

With **UnInstaller 4**, you can tell the program you need a certain amount of memory and it will find it; you can remove an application from one PC and copy it to another PC; and you can delete all applications in one folder with one action. $39.95.
Contact: MicroHelp, Inc., Marietta, GA, (800) 777-3322 or (770) 516-0899; http://www.microhelp.com.
Circle 1019 on Inquiry Card.

SPSS 7.5 for Windows, a statistical package for Windows 95 and NT 4.0, includes an ODBC query wizard; a Statistical Advisor; the ability to save results in JPEG or HTML formats; and an internal scripting language. Base system, $695.
Contact: SPSS, Inc., Chicago, IL, (800) 543-2185 or (312) 329-2400; http://www.spss.com.
Circle 1020 on Inquiry Card.

HARDWARE

Accessories

Digital Camera

With the Pixera Visual Communication System, you can capture, manipulate, enhance, and manage 24-bit-color images in resolutions up to 1 million pixels. The Pixera Personal ($795) includes a digital-camera system with fixed-focus and macro lenses; a PCI card or PC Card; cable; and software. The Pixera Professional's ($1195) digital-camera system features a variable-focus C-mount lens, ranging from 1 inch to infinity.

Contact: Pixera Corp., Los Gatos, CA, (888) 474-9372 or (408) 341-1800; http://www.pixera.com.
Circle 1022 on Inquiry Card.

Network Audio Communications

Mediatrix's Audiotrix Phone package (US$495) includes a plug-and-play audio adapter and Texas Instruments' TMS320C50 DSP; a handset with on/off volume control, a headset connector, hands-free speaker operation, a built-in microphone, and a built-in amplified speaker; and customized CTI software for Unix and Windows 3.1x, 95, and NT. The Audiotrix device employs 16-to-1 ACELP hardware voice-compression technology; offers 16-bit full-duplex stereo digital audio; and supports Microsoft DirectX 3.
Contact: Mediatrix Peripherals, Inc., Sherbrooke, Quebec, Canada, (800) 820-8749 or (819) 829-8749; http://www.mediatrix.com.
Circle 1023 on Inquiry Card.

Add-Ins

3-D Video Accelerator

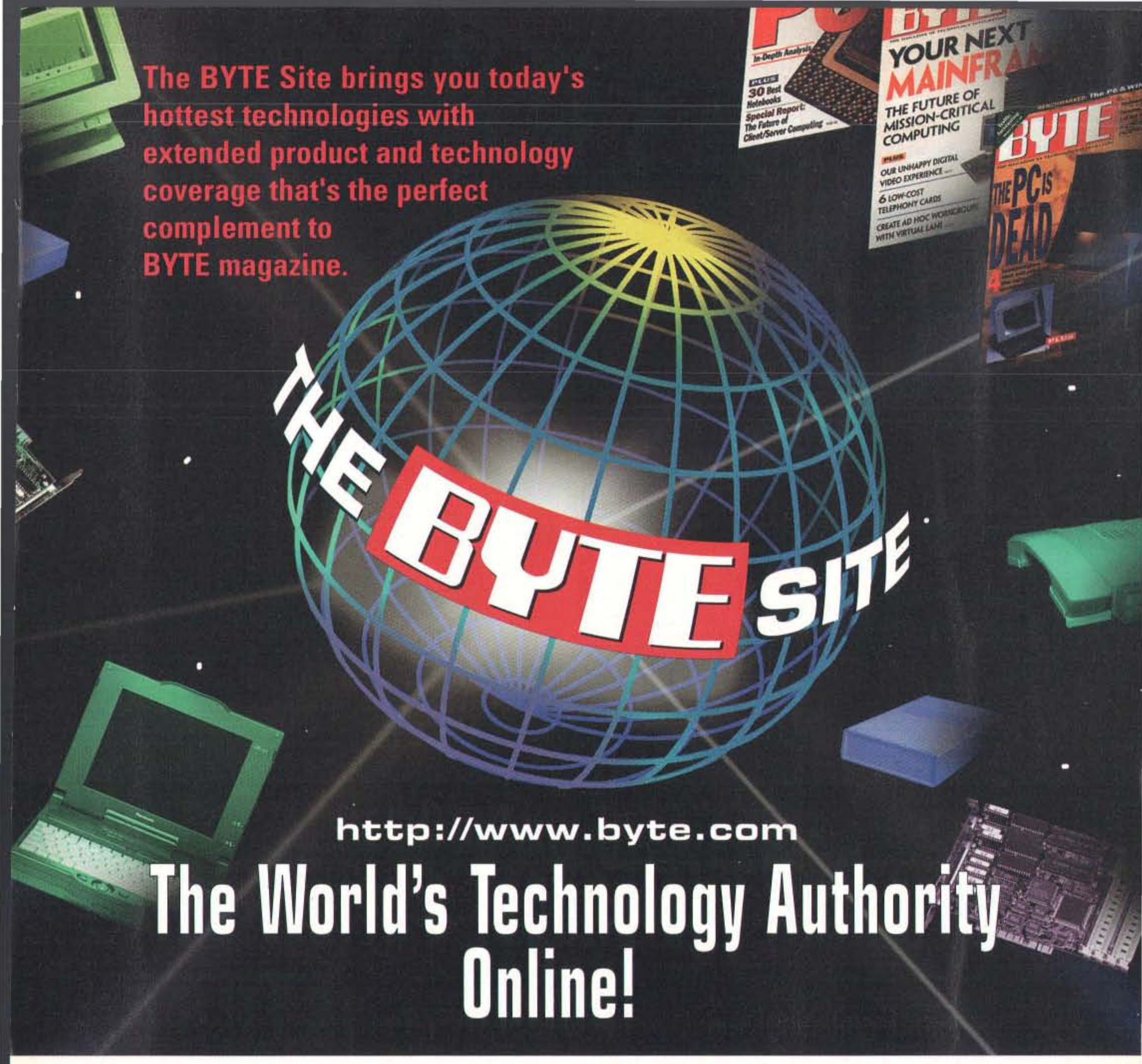
With Velocity 3D Windows (with 4 MB of memory, $199; with 8 MB, $299), you get a 64-bit 2-D acceleration engine, a 3-D rendering accelerator, and a Digital Video Engine delivered by the S3 ViRGE VX graphics-controller ASIC. The card delivers up to 16.7 million colors and resolutions up to 1600 by 1200 pixels with refresh rates up to 160 Hz.
Contact: STB Systems, Inc., Richardson, TX, (888) 234-8750 or (214) 234-8750; http://www.stb.com.
Circle 1024 on Inquiry Card.

Video for Sun Workstations

If you use a Sun UltraSparc or SparcStation 5, 10, or 20 workstation, the XVideo Xtra ($7995) may be for you. The video-overlay card supports resolutions up to 1280 by 1024 pixels and lets you use your favorite frame buffer. NTSC video displays at 60 fields per second and at a resolution of 640 by 480; PAL and SECAM display at 50 fps and at a resolution of 768 by 576.
Contact: Parallax Graphics, Inc., Santa Clara, CA, (408) 727-2220; http://www.parallax.com.
Circle 1025 on Inquiry Card.

Pentium Pro System Board

Targeted to deliver RISC-level performance with Intel's 440FX chip set, the W6-LI (with sound, $746; without sound, $702) features 150- to 200-MHz Pentium Pro CPUs; Enhanced IDE, PCI, and ISA expansion slots; Ultra Wide SCSI (up to 40 MBps); and optional 16-bit Sound Blaster–compatible sound.
Contact: Micronics Computers, Inc., Fremont, CA, (800) 577-0977 or (510) 651-2300; http://www.micronics.com.
Circle 1026 on Inquiry Card.



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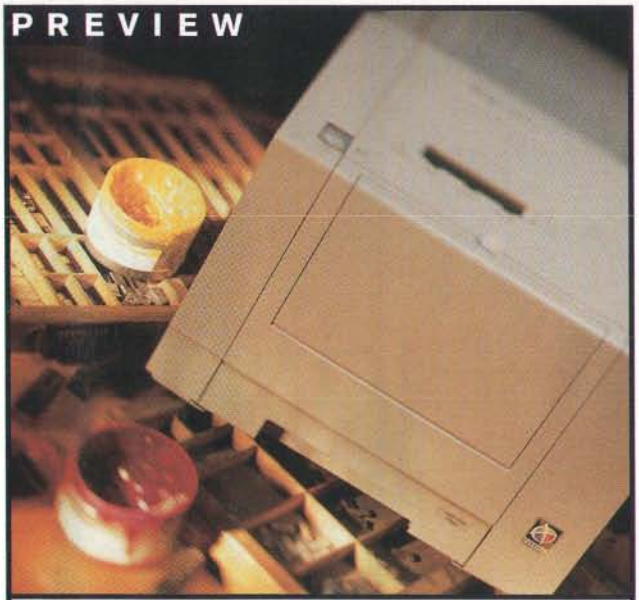
Connectivity

ISDN Terminal Adapter

The Omni TA128 ISDN modem ($399) features two serial DTE interfaces, so you can connect it as if it were two modems using a single ISDN line. The modem provides ISDN connection at 128 Kbps and gives you the option of using STAC compression over PPP, or V.42bis compression over V.120. Both options enable the Omni TA128 to reach optimal throughput speeds up to 460.8 Kbps.

Contact: ZyXel Communications, Anaheim, CA, (800) 255-4101 or (714) 693-0808; http://www.zyxel.com.
Circle 1028 on Inquiry Card.



Tektronix Phaser 350 (supports Macs and PCs)
$3495
Circle 1021 on Inquiry Card.

Tektronix, Inc.
Wilsonville, OR
(800) 835-6100
(503) 682-7377
fax: (503) 682-2980
http://www.tek.com/color_printers/

Phaser 350 Beats Laser Printers

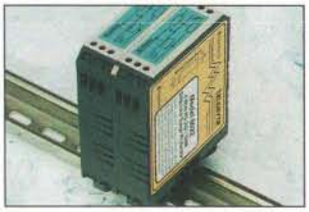
Today's low-cost color ink-jet printers deliver high-quality output, but their speed is another matter. That's why we were so impressed with the Tektronix Phaser 350. This solid-ink color printer provides equivalent or better speed and output quality compared to today's fast color laser printers, but with great convenience and reliability at a lower cost.

The Phaser 350's new high-speed Fast Color print mode produces full-color pages at 6 pages per minute. No color laser printer costing anywhere near the 350's $3495 base price can do that. Tektronix managed this speed upgrade by finding clever ways to drop out dots (the base resolution is 600 by 300 dpi) without severely affecting the print quality. True, you can notice a difference depending on the type of document you print, but the color quality is still very good. If you need the best color, you can opt for the 4-ppm speed.

The Phaser 350 uses four (CYMK) color ink sticks that resemble wax crayons and drop into shape-coded slots. Maintenance is almost nonexistent, and setting up the 350 is easier than dealing with color laser printers, which can be cumbersome and sometimes temperamental. The Phaser 350 also prints on just about any type of paper.
–Jon Pepper

Industrial Surge Protection

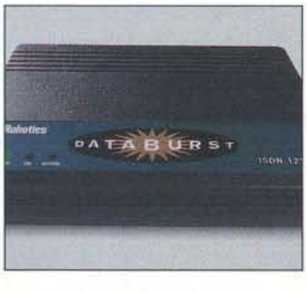
Designed to protect data-communication lines in industrial environments, Telebyte's Model 8022 ($145) suppresses damaging transient overvoltage pulses caused by nearby lightning strikes, power-line disturbances, electrostatic discharge, and industrial load switching. The Model 8022 accommodates four-wire networks using RS-232-based signals or other signals whose amplitude falls within +/-15 V.



Contact: Telebyte Technology, Inc., Greenlawn, NY, (800) 835-3298 or (516) 423-3232; http://www.telebyteusa.com.
Circle 1029 on Inquiry Card.

ISDN Parallel-Port Terminal Adapter

The DataBurst ISDN 128K provides uncompressed throughput of 128 Kbps and compressed data transfer rates up to 512 Kbps. The integrated NT-1 version ($279) provides direct connection to an ISDN wall jack; the S/T version ($239) is designed for use with stand-alone NT-1s or PBXes.



Contact: U.S. Robotics, Skokie, IL, (800) 877-2677 or (847) 982-5001; http://www.usr.com.
Circle 1027 on Inquiry Card.

Data Acquisition

Network-Based Data Acquisition

Available for NuBus Macs running System 7.0 and PCI- and ISA-bus PCs running Windows 95, instruNet places the analog electronics in boxes outside the computer and the noisy digital electronics inside the computer. A base instruNet system (call company for prices) consists of a controller board with a 32-bit microprocessor, 256 KB of RAM, and 10 counter/timer channels; one external data acquisition box; and a cable.

Contact: GW Instruments, Inc., Somerville, MA, (617) 625-4096; http://www.gwinst.com.
Circle 1030 on Inquiry Card.

Graphics

3-D Graphics Accelerator

Based on the Oxygen chip, a scalable, pipelined 3-D graphics-rendering and texture-mapping processor, the Oxygen 402 card ($4995) provides four Oxygen chips operating in parallel; 32 MB of synchronous DRAM; resolutions from 640 by 480 pixels to 1600 by 1200; color depths of 8, 16, or 32 bits per pixel; Gouraud shading and hardware dithering; and hardware z-buffer depths of 16 or 24 bits.

Contact: Dynamic Pictures,

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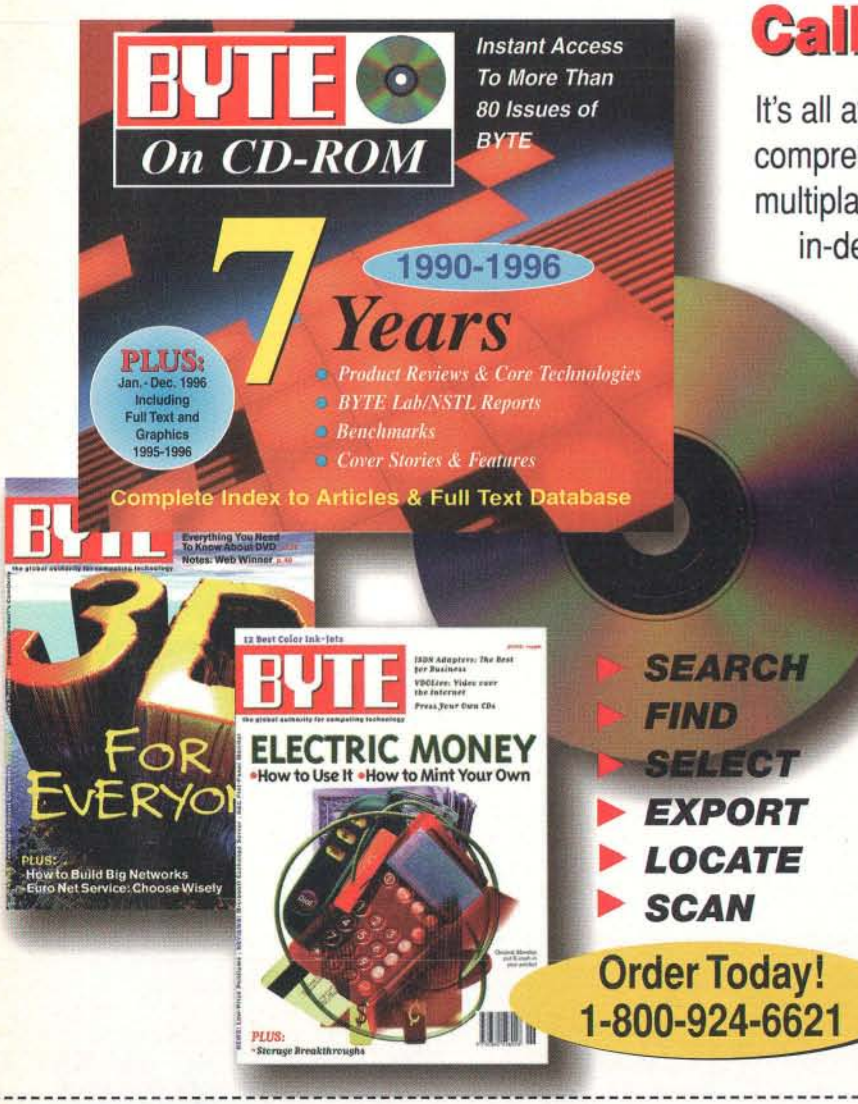
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Networking

Hand-Held Network Diagnostic Tool

You can verify network connections and diagnose network problems with the Fluke OneTouch Network Assistant. The device executes a series of cable- and packet-level connectivity tests and performs individual tests for hubs and NICs. Two different versions are available: a 10-Mbps Ethernet configuration ($3695) and a combination 10-/100-Mbps Ethernet configuration ($4995).
Contact: Fluke Corp., Everett, WA, (800) 443-5853 or (206) 356-5500; http://www.fluke.com/nettools/.
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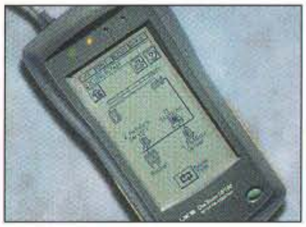

Peripherals

Six-Color Wide-Format Printer

A Pantone Hexachrome ink-jet printer, the SpectraJet Hifi (approximately $10,000) lets you work in formats ranging from 8½ to 36 inches wide and up to 10 feet long. The printer comes with six 500-milliliter reservoirs for yellow, orange, magenta, cyan, green, and black ink. The SpectraJet Hifi has 24-bit color addressing with a 300-dpi resolution in draft and final modes to create up to 16 million colors.
Contact: Mutoh America, Inc., Phoenix, AZ, (800) 996-8864 or (602) 276-5533; http://www.mutoh.com.
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Multimedia Notebook Projector

Weighing about 11 pounds, the Lightbook projector ($4999) provides plug-and-play SVGA image support and integrated video with direct connection of video sources, such as VCRs and laserdiscs. The compact, rugged projector supports PCs and Macs and comes with an auto-switching power supply for U.S. and European electrical outlets. The Proxima Cyclops remote control lets you open files, click on hot buttons, and perform other mouse actions from anywhere in the room.
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Offering a data transfer rate of 1.5 MBps, the WangDAT 3800 (internal model, $1299; external model, $1460) features 100×speed-search mode, a fast SCSI connector, and a 1-MB data buffer. The 4-mm DDS-2 DAT drive provides 4 GB of native storage and jumps to 8 GB when you enable the on-board hardware data compression.
Contact: Tecmar Technologies, Inc., Longmont, CO, (800) 422-2587 or (303) 682-3700; http://www.tecmar.com.
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Storage

Desktop RAID Subsystems for Sparc and Windows NT

The RD10/25 ($17,500) provides up to 25.2 GB of storage for Sparc, UltraSparc, and Windows NT environments. The subsystem includes a 32-bit embedded RISC-based processor; 16 MB of cache memory; six hot-swappable drives; and six dedicated controllers that increase the data throughput to 133 MBps. It offers 0, 1, 3, 5, and 0+1 RAID levels and a scalable 16- to 128-MB cache memory.
Contact: Integrix, Inc., Newbury Park, CA, (800) 300-8288 or (805) 376-1000; http://www.integrix.com.
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13-GB Tape-Storage Solution

Utilizing Tandberg Data's Multichannel Linear Recording technology, the MLR1 Tape Storage Solution (internal model, $2749; external model, $2949) features a Tandberg MLR1 tape drive; the Seagate Software Storage Suite for Desktop and Servers on CD-ROM, which is provided in English, French, German, and Spanish; a 13-GB Imation MLR Tape Cartridge, which has a 26-GB capacity with hardware data compression; and cables for connection to 16-bit wide or 8-bit narrow SCSI connectors.
Contact: Tandberg Data, Inc., Simi Valley, CA, (800) 826-3237 or (805) 579-1000; http://www.tandberg.com.
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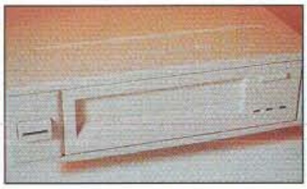

Systems

Notebook Has Removable MO Drive

With the PowerMedia III Plus notebook's (from $2875) removable 3½-inch read/write MO drive, you can store graphics and sound files, video sequences, and large databases and run applications directly from the drive. The notebook comes with a 12.1-inch TFT or DSTN SVGA LCD screen; a 75-, 90-, 100-, 120-, 133-, 166-, or 200-MHz Pentium processor; 8 MB of RAM, upgradable to 16 or 32 MB; a 256-KB L2 pipelined burst cache; 2 MB of EDO VRAM; an IRDA interface; a PC Card slot; SRS 3-D surround sound; a removable 1.44-MB floppy drive; and a removable 1.0-, 1.3-, or 2.1-GB hard drive.
Contact: Astro Research, Monterey Park, CA, (818) 293-1651; http://www.astronote.com.
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PC with 12-Speed CD-ROM

The top-of-the-line Innova Media MT 9800 (about $3299) comes with a 200-MHz Pentium CPU, 32 MB of EDO DRAM, a 3.1-GB hard drive, a 12-speed CD-ROM drive, an Iomega 100-MB Zip drive, 3-D video/graphics, wave-table audio with 1 MB of ROM storage, and a six-button, eight-point directional game pad. The PC also includes a 33.6-Kbps SVD modem, stereo speakers, a 64-bit graphics accelerator with hardware-assisted MPEG playback, a 16-bit sound card with 3D Spatializer, a speakerphone, a microphone, and an IRDA interface.
Contact: Canon Computer Systems, Inc., Costa Mesa, CA, (714) 438-3000; http://www.ccsi.canon.com.
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codetalk

You Can Start Developing Now

Moss Micro's Start Developing tool guides you down the Visual Basic path.

By Rick Grehan

One of the original goals of Visual Basic (VB) was to simplify programming. (Remember, the acronym *BASIC* stands for Beginner's All-purpose Symbolic Instruction Code.) Those of us who were unable to tolerate the rigors of C and C++ could find refuge not only in VB's visual integrated development environment (IDE) but in the language's less complex syntax as well.

On the one hand, then, a tool like Moss Micro's Start Developing for Visual Basic (which is compatible with VB 3.0 and both 16- and 32-bit versions of VB 4.0) is a surprise. Why would I need something to simplify a thing that was supposed to be simple in the first place? On the other hand, Start Developing is no surprise. Some activities are complicated no matter how hard you try to simplify them. Programming is one of them.

Start Developing for Visual Basic comprises four main components. The first is its application wizard, which guides you through those first unsteady steps of constructing an application. A series of dialog boxes prompt you for the characteristics of your application: Will it use a single- or multiple-document interface? What kind of database support (if any) will it require? Open Database Connectivity (ODBC)? Jet? Would you like it to have a toolbar? The result is a functioning skeleton of a program to which you can begin attaching the flesh and muscle of application code.

The second component is a collection of "assistants," which are VB add-ins that eliminate much of the drudge work involved with producing quality code. For example, the error-handling assistant automatically inserts error-exit code into selected (or all, if you wish) procedures and functions in your application.

Another assistant collects project statistics. For example, it identifies procedures and functions lacking in error-handling code. (Shame on you. You should have used the other assistant to put it there.) It also reports the average number of lines in a module, the average number of lines in a routine, and so on.

OFX modules are the third, and perhaps most important, component of Start Developing. These modules include a large collection of library routines that cover areas as fundamental as string manipulation (e.g., scanning a string of tokens separated by a delimiter; indenting, left-justifying, right-justifying, or centering lines; and more) to areas as specific as reading and writing the INI files or the registry.

Start Developing even provides a set of routines that offers a unified interface for dealing with INI files and/or registry entries. There are also numerous routines for conquering ODBC either directly or through remote data objects (RDOs), as well as VB/SQL and Jet.

Given that the OFX modules represent a treasure trove of routines to draw from, it would be nice if you could simply dip into that trove at will. It's not that simple, but the documentation describes a roundabout way of "stealing" the routines. You just create a dummy application using Start Developing's application wizard. The dummy application includes all the routines you want, so you can copy out whatever ones that you need. You have to be careful, however, because many of the routines are interdependent. Fortunately, the manual gathers related modules together, so you don't ever have to worry about interdependencies.

WHERE TO FIND

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Finally, there's Office Book, a kind of miniapplication that you can, in turn, embed in your application. It's an ODBC-based contact manager implemented as an OLE server. In truth, this seems a little out of place with the rest of the product, but if you need a contact manager anywhere in your product, here it is.

The benefits from this package come not only from its software. Although it covers only six pages, the manual's "Ten Laws for Visual Basic Development" is a must-read for all VB programmers. (A note to Moss Micro: Do the VB programming community a favor and put these laws up on your Web page.)

I noticed that you can also find some of the features provided by Start Developing's assistants—automatic error-code writing, function-header templates, and source code statistics—in MicroHelp's Code Complete Code Analyst and AutoCoder (see the July 1996 Codetalk). But this overlap detracts from neither product. VB programmers can probably use more of this stuff, not less. **B**

Rick Grehan is a senior technical editor for BYTE reviews. You can reach him by sending e-mail to **rick_g@bix.com**.

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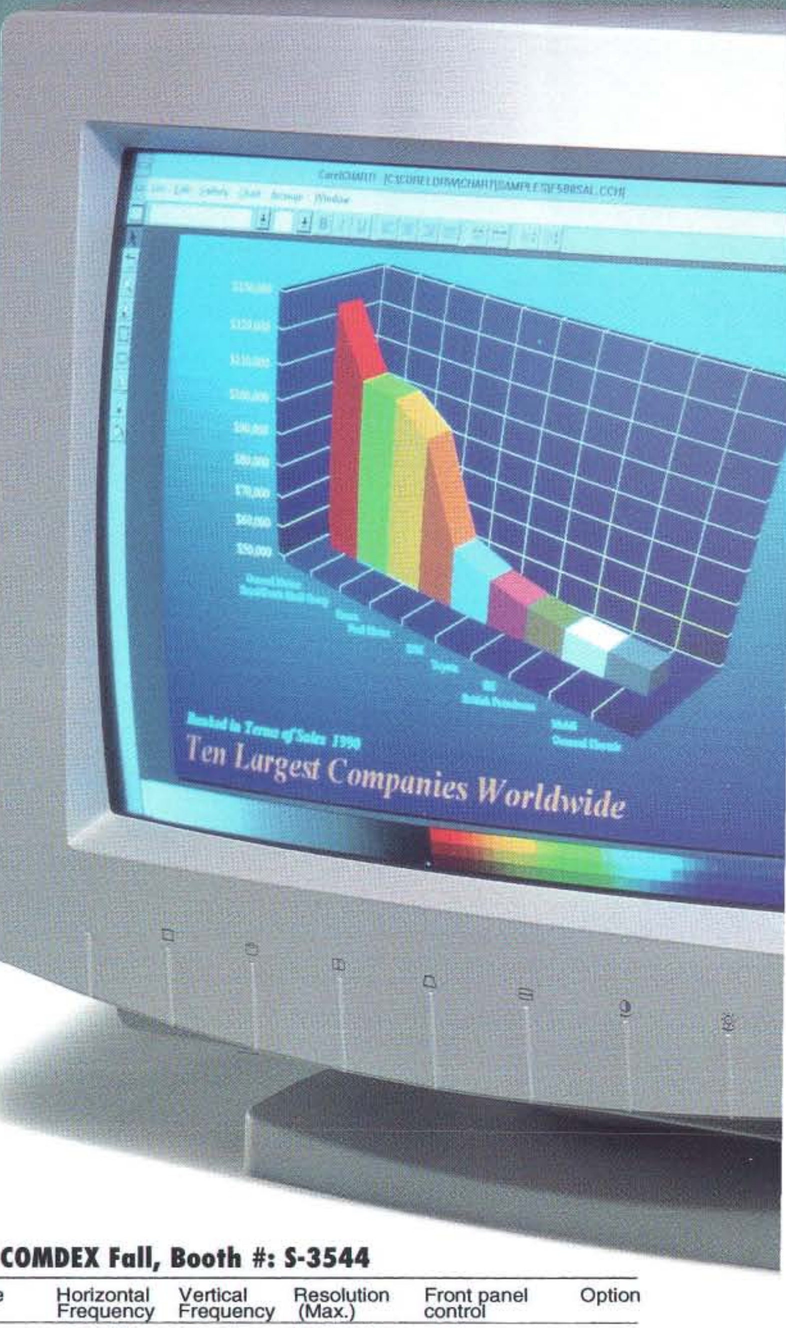
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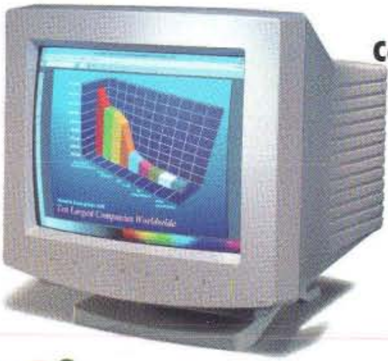

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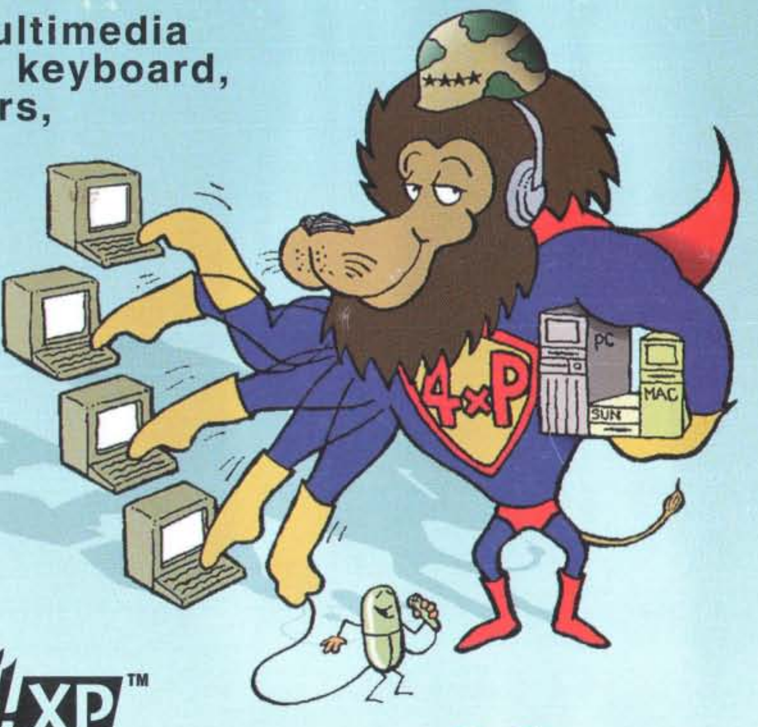

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